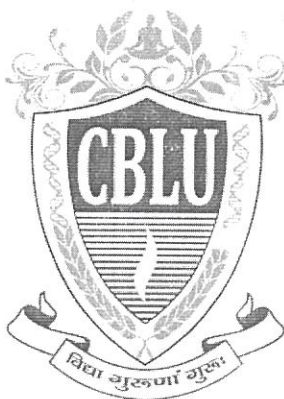


Ch. Bansi Lal University, Prem Nagar
(A State University established under Haryana Act No. 23 of 2014)



**Scheme of Examination
for
Chemistry Subject
in
Under Graduate Programmes**

as per NEP 2020

Curriculum and Credit Framework for Undergraduate Programmes
(Multiple Entry-Exit, Internships and Choice based credit system LOCF)

With the effect from the session 2024 25 (in phased manner)

DEPARTMENT OF CHEMISTRY

Ch. Bansi Lal University, Prem Nagar-127031
Bhiwani
HARYANA, INDIA

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MD, [Signature], [Signature], [Signature] Ravi Kant

Chaudhary Bansi Lal University, Bhiwani

(A State University established under Haryana Act No. 25 of 2014)



**Examination Scheme and Syllabus
For
Undergraduate Programme
In
Chemistry Subject**

as per NEP 2020

**Curriculum and Credit Framework for Postgraduate Programmes
(Multiple Entry-Exit, Internship and Choice Based Credit System LOCF)**

With effect from the Session 2024-25 (in phased manner)

**DEPARTMENT OF CHEMISTRY
FACULTY OF PHYSICAL SCIENCES
Chaudhary Bansi Lal University, Prem Nagar– 127031
BHIWANI
HARYANA, INDIA**

Scheme A- It is applicable to Undergraduate programmes (Multidisciplinary) of Chaudhary Bansi Lal University, Bhiwani under NEP-2020 w.e.f. the Academic Session 2024-25.

Scheme B- It is applicable to Undergraduate Programmes with Single Major after first year of UG Programme (Multidisciplinary) of Chaudhary Bansi Lal University, Bhiwani under NEP-2020 w.e.f. the Academic Session 2024-25.

Scheme C- It is applicable to Undergraduate Programmes with Single Major of Chaudhary Bansi Lal University, Bhiwani under NEP-2020 w.e.f. the Academic Session 2024-25.

Scheme D- It is applicable to Undergraduate Programmes (Interdisciplinary) of Chaudhary Bansi Lal University, Bhiwani under NEP-2020 w.e.f. the Academic Session 2024-25.

1. Key Terms

1.1 Academic Year and Semester: Two consecutive (one odd and one even) semesters will constitute one academic year. A semester will consist of 90 days of academic work.

1.2 Credit: A unit by which the course work is measured. It determines the number of hours of instructions required per week over the duration of one semester. For calculation of the teaching hours, one credit means one hour of lecture or one hour of tutorial or one hour of seminar or two hours of practicum/laboratory work per week over the duration of a semester.

1.3 Learning Outcome based Curriculum Framework (LOCF): The learning outcomes of the programme are mapped against well-defined Course Learning Outcomes (CLOs).

1.4 Choice Based Credit System (CBCS): The CBCS provides choices to students to select disciplinary and interdisciplinary courses to fit into their own requirements and to learn at their own pace within the framework.

1.5 Programme: A programme is made up of courses and leads to the award of a Certificate, Diploma or Degree after completing requisite courses successfully.

1.6 Course: A course refers to component of a programme. A course may comprise of lectures/tutorials/practicum or laboratory work/field practice/project work/seminar/community engagement and service/internship/dissertation, etc. or any combination of these.

1.6.1 Lecture: Component of a course which is taught by a teacher through lectures covering the contents of a course.

1.6.2 Tutorial: Component of a course which involves problem-solving, learning through discussions and remedial teaching related to the contents and periphery of a course with the direct involvement of a teacher.

1.6.3 Practicum: A course or a component of a course which enables students to learn or to attain skills or to get procedural knowledge for the contents of a course through practical/laboratory activity/project and to apply learnt/studied principles/theory/concepts related to the chosen field of learning, work/vocation, or professional practice in the field of learning, work/vocation under the supervision of a teacher.

1.6.4 Seminar: A course or a component of a course which makes students to learn a specific

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topic through in-depth exploration and analysis of facts about the topic in a set-up that involves presentation, interactive discussions and collaborative learning under the supervision of a teacher.

1.6.5 Internship: A course requiring students to participate in professional employment-related activity or work experience or co-operative education activity with an entity external to the educational institution normally under the supervision of an employee of an organization or an individual professional. A key aspect of the internship is induction into actual, formal and organized work situations. Internship involves working with local industry (Government or Private organizations), business establishments, artists, craft persons, etc. to provide opportunities for students to actively engage in on-site experiential learning.

1.6.6 Studio Activity: A studio activity involves engagement of students in creative, artistic or experimental activities involving visual, digital, audio, video and other professional experiential work.

1.6.7 Field Work/Practice/Survey/Project: A course or a component of course which enables students to participate in field-based learning/project, involving application of knowledge in solving/analyzing/exploring a real-life situation/difficult problem under the supervision of a teacher/mentor.

1.6.8 Project Work: A course or a component of a course which facilitates students to apply their knowledge, skills and critical thinking ability to complete a specific task in a given time frame through conceptualization, exploration and analysis of research-based activities to suggest tangible solutions for a given problem related to the chosen field of learning.

1.6.9 Community Engagement and Service: A course or a component of a course which exposes the students to the socio-economic issues prevailing in society so that the theoretical learning can be supplemented by actual life experiences to understand and generate solutions to real-life problems.

1.7 Major and Minor Subject: Major subject is a subject of choice in a discipline which equips a student with knowledge, understanding and skills majorly in the chosen field of learning contributing to the core of the programme.

Minor subject helps a student to gain a broader understanding in addition to the Major subject. The courses in Major subjects will be Core Courses (CC), while a Minor subject will include CC as well as Vocational Courses (VOC).

1.7.1 Core Course (CC): A compulsory course of a subject aimed to cover the basics of Major/Minor subject.

1.7.2 Vocational Courses (VOC): A vocational course is focused on practical work, preparing students for a particular skilled profession. Such courses develop capacities for sustenance, work, and economic participation and develop values and sensibilities toward physical work.

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Ch. Bansi Lal University, Prem Nagar, Bhiwani

Scheme of Examination for Chemistry Subject in Under Graduate Programmes
as per NEP 2020 Curriculum and Credit Framework for Undergraduate Programmes
(Multiple Entry-Exit, Internships and Choice Based Credit System LOCF) with effect from session 2024-25 (in a phased manner)

Semester-I

Course Type Total Credits	Applicable Scheme	Course Code	Nomenclature of the Course	Credits	Contact hours per week	Internal Assessment Marks	End term Examination Marks	Total Marks	Examination Hrs.
CC-1 MCC-1 04 Credits	Scheme A, B & C	24UN-CHE-101	Chemistry-I	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
			Physical Chemistry - I	03	03	20	50	70	03
MCC-2 04 Credits	Scheme C Only	24UN-CHE-102	Practical	01	02	10	20	30	03
*CC-M1 02 Credits	Scheme A, B & D	24UN-CHE-103	Minor Chemistry - I	02	02	15	35	50	03
CC-M1 04 Credits	Scheme C	From Available CC-1/MCC-1 of 4 credits as per NEP							
MDC-1 03 Credits	Scheme A, B & C	From Available pool of Multidisciplinary Courses from a subject of different discipline as per NEP.							
AEC-1 02 Credits	A, B & C	From Available pool of Ability Enhancement Courses as per NEP							
SEC-1 03 Cr.	A, B & C	From Available pool of Skill Enhancement Courses as per NEP							
VAC-1 02 Credits	A, B & C	From Available pool of Value Added Courses as per NEP							

*For students who opt Chemistry as a minor subject.

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Semester-II

Course Type Total Credits	Applicable Scheme	Course Code	Nomenclature of the Course	Credits	Contact hours per week	Internal Assessment Marks	End term Examination Marks	Total Marks	Examination Hrs.
CC-2 MCC-3 04 Credits	Scheme A,B & C	24UN-CHE-201	Chemistry – II	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
			Physical Chemistry Skill - I	03	03	20	50	70	03
DSEC-1 04 Credits	Scheme C Only	24UN-CHE-202	Practical	01	02	10	20	30	03
*CC-M2 02 Credits	Scheme A, B & D	24UN-CHE-203	Minor Chemistry - II	02	02	15	35	50	03
CC-M2 04 Credits	Scheme C Only	From Available CC-2/MCC-3 of 4 credits as per NEP							
MDC-2 03 Credits	Scheme A, B, C & D	From Available pool of Multidisciplinary Courses from a subject of different discipline as per NEP.							
AEC-2 02 Credits	Scheme A,B & C	From Available pool of Ability Enhancement Courses as per NEP							
SEC-2 03 Credits	Scheme A, B, C & D	From Available pool of Skill Enhancement Courses as per NEP							
VAC-2 02 Credits	Scheme A & C	From Available pool of Value Added Courses as per NEP							
Internship 04 Credits	Scheme A & C	Internship of 04 Credits of 4-6 weeks duration after 2 nd Semester							

*For students who opt Chemistry as a minor subject.

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Semester-III

Course Type Total Credits	Applicable Scheme	Course Code	Nomenclature of the Course	Credits	Contact hours per week	Internal Assessment Marks	End term Examination Marks	Total Marks	Examination Hrs.
CC-3 MCC-4 04 Credits	Scheme A, B, C & D	24UN-CHE-301	Chemistry – III	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
MCC-5 04 Credits	Scheme B & C	24UN-CHE-302	Inorganic Chemistry – I	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
MCC-2 04 Credits	Scheme B only	24UN-CHE-102	Physical Chemistry - I	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
CC-M3 04 Credits	Scheme A, C & D	From Available CC-3/MCC-4 of 4 credits as per NEP							
CC-M3 (V) 04 Credits	Scheme B only	From Available pool of Minor (Vocational) Courses VOC-1							
MDC-3 03 Credits	Scheme A, B, C & D	From Available pool of Multidisciplinary Courses from a subject of different discipline as per NEP.							
AEC-3 02 Credits	Scheme A, B, C & D	From Available pool of Ability Enhancement Courses as per NEP							
SEC-3 03 Credits	Scheme A, B, C & D	From Available pool of Skill Enhancement Courses as per NEP							
VAC-3 02 Credits	Scheme C only	From Available pool of Value Added Courses as per NEP							

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EC-M7 (V)	Scheme A & D	From Available pool of Skill Enhancement Courses As Per NEP
SEC-4	Scheme C only	

- Note: 1. Four Credits of internship, earned by a student during summer internship after 2nd semester or 4th semester, will be taken into account in 5th semester of a student who pursue 3year UG Programme without taking exit option.
2. 16 credits earned in two subjects studied in first year, other than major subject opted in second year, will be taken into account as Credits of Minor as, per Scheme-B of the ordinance.

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Semester-V

Course Type Total Credits	Applicable Scheme	Course Code	Nomenclature of the Course	Credits	Contact hours per week	Internal Assessment Marks	End term Examination Marks	Total Marks	Examination Hrs.
CC-5 MCC-9 04 Credits	Scheme A, B, C & D	24UN-CHE-501	Chemistry – V	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
			Inorganic Chemistry – II	03	03	20	50	70	03
MCC-10 04 Credits	Scheme B & C	24UN-CHE-502	Practical	01	02	10	20	30	03
			Elective Chemistry- IV	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
DSE-2 04 Credits Select one option	Scheme B & C	24UN-CHE-503	OR						
			Elective Chemistry- V	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
DSE-3 04 Credits Select one option	Scheme B & C	24UN-CHE-504	OR						
			Elective Chemistry- VI	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
DSE-3 04 Credits Select one option	Scheme B & C	24UN-CHE-505	OR						
			Elective Chemistry- VII	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
DSE-3 04 Credits Select one option	Scheme B & C	24UN-CHE-506	OR						
			Elective Chemistry- VIII	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
DSE-3 04 Credits Select one option	Scheme B & C	24UN-CHE-507	OR						
			Elective Chemistry- IX	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
DSE-3 04 Credits Select one option	Scheme B & C	24UN-CHE-508	OR						
			Elective Chemistry- X	03	03	20	50	70	03
			Practical	01	02	10	20	30	03

CC-M5 (V)		Practical	01	02	10	20	30	03
04 Crédits	Scheme A, C & D	From Available pool of Minor (Vocational) Courses VOC-1						
Internship 04 Credits	Scheme A, B, C & D	Internship of 04 Credits of 4-6 weeks duration after 4 th Semester (If not done after 2 nd & 4 th Semester)						

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Semester-VII (For Honours/Honours with Research in Chemistry)

Course Type Total Credits	Applicable Scheme	Course Code	Nomenclature of the Course	Credits	Contact hours per week	Internal Assessment Marks	End term Examination Marks	Total Marks	Examination Hrs.
CC-H1 04 Credits	Scheme B & C	24UN-CHE-701	Physical Chemistry – IIJ	04	04	30	70	100	03
CC-H2 04 Credits	Scheme B & C	24UN-CHE-702	Inorganic Chemistry – III	04	04	30	70	100	03
CC-H3 04 Credits	Scheme B & C	24UN-CHE-703	Organic Chemistry – III	04	04	30	70	100	03
DSE-6 04 Credits Select one option	Scheme B & C	24UN-CHE-704	Advanced Chemistry-I	04	04	30	70	100	03
		OR							
		24UN-CHE-705	Advanced Chemistry-II	04	04	30	70	100	03
		OR							
		24UN-CHE-706	Advanced Chemistry-III	04	04	30	70	100	03
PC-H1	Scheme B & C	24UN-CHE-707	Practical Chemistry	04	08	30	70	100	08
CC-HM1	Scheme B & C	From the Available core courses in Minor Subjects of 04 Credits As Per NEP							









Semester-VIII (For Honours in Chemistry)

Course Type Total Credits	Applicable Scheme	Course Code	Nomenclature of the Course	Credits	Contact hours per week	Internal Assessment Marks	End term Examination Marks	Total Marks	Examination Hrs.
CC-H4 04 Credits	Scheme B & C	24UN-CHE-801	Physical Chemistry – IV	04	04	30	70	100	03
CC-H5 04 Credits	Scheme B & C	24UN-CHE-802	Inorganic Chemistry – IV	04	04	30	70	100	03
CC-H6 04 Credits	Scheme B & C	24UN-CHE-803	Organic Chemistry – IV	04	04	30	70	100	03
DSE-7 04 Credits Select one option	Scheme B & C	24UN-CHE-804	Advanced Chemistry- IV	04	04	30	70	100	03
		OR							
		24UN-CHE-805	Advanced Chemistry- V	04	04	30	70	100	03
		OR							
PC-H2 04 Credits	Scheme B & C	24UN-CHE-806	Advanced Chemistry- VI	04	04	30	70	100	03
		24UN-CHE-807	Practical Chemistry	04	08	30	70	100	08
CC-HM2 04 Credits	Scheme B & C	From the Available core courses in Minor Subjects of 04 Credits As Per NEP							


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Semester-VIII (For Honours with Research in Chemistry)

Course Type Total Credits	Applicable Scheme	Course Code	Nomenclature of the Course	Credits	Contact hours per week	Internal Assessment Marks	End term Examination Marks	Total Marks	Examination Hrs.
CC-H4 04 Credits	Scheme B & C	24UN-CHE-801	Physical Chemistry – IV	04	04	30	70	100	03
CC-H5 04 Credits	Scheme B & C	24UN-CHE-802	Inorganic Chemistry – IV	04	04	30	70	100	03
Project / Dissertation 12 Credits	Scheme B & C	24UN-CHE-808	Project / Dissertation in Chemistry	12	--	--	--	300	--
CC-HM2 04 Credits	Scheme B & C	From the Available core courses in Minor Subjects of 04 Credits As Per NEP							





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Pool of MDC, VAC, SEC and VOC Courses in the subject of Chemistry to be offered to the University Pool

Course Type Total Credits	SEM	Applicable Scheme	Course Code	Nomenclature of the Course	Credits	Contact hours per week	Internal Assessment Marks	End term Examination Marks	Total Marks	Examination Hrs.
MDC-1 03 Credits	I	Scheme A, C & D	24UN-CHE-MDC101	Introductory Chemistry - I	02	02	15	35	50	03
				Practical	01	02	05	15	20	03
MDC-2 03 Credits	II	Scheme A, C & D	24UN-CHE-MDC201	Introductory Chemistry - II	02	02	15	35	50	03
				Practical	01	02	05	15	20	03
MDC-3 03 Credits	III	Scheme A, B, C & D	24UN-CHE-MDC301	Introductory Chemistry - III	02	02	15	35	50	03
				Practical	01	02	05	15	20	03
VAC-3	III	Scheme C	24UN-CHE-VAC301	Chemistry in everyday life	02	02	15	35	50	03
	IV			Chemistry of Food, Flavors and Colorants	02	02	15	35	50	03
VAC-4	IV	Scheme C	24UN-CHE-VAC401	Agriculture Chemistry	02	02	15	35	50	03
SEC-2	II	Scheme A, C & D	24UN-CHE-SEC201	Chemistry of Food, Flavors and Colorants	02	02	15	35	50	03
				Practical	01	02	05	20	25	03
SEC-3	III	Scheme A, B, C & D	24UN-CHE-SEC301	Analytical Chemistry	02	02	15	35	50	03
				Practical	01	02	05	20	25	03
SEC-4	VI	Scheme C only	24UN-CHE-SEC601	Food Adulteration Testing	02	02	15	35	50	03
				Practical	01	02	05	20	25	03
CC-M3 (V)	III	Scheme B only	24UN-CHE-	Chemistry of Fertilizers and Pesticides	03	03	20	50	70	03

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CC-M5 (V)	V	Scheme A & C	VOC-1	Practical	01	02	10	20	30	03
CC-M4 (V)	IV	Scheme A, B & C	24UN-CHE- VOC-2	Chemistry of Cosmetics and Perfumes	03	03	20	50	70	03
CC-M5 (V)	VI	Scheme B only		Practical	01	02	10	20	30	03
CC-M6 (V)		Scheme C only	24UN-CHE- VOC-3	Green Laboratory Techniques	03	03	20	50	70	03
CC-M7 (V)		Scheme A only		Practical	01	02	10	20	30	03




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Course composition- Theory/ Theory + Practical					
Course Credit	Internal Assessment marks		End term exam marks	Total marks	
2	15		35	50	
3	20		50	70	
4	30		70	100	
Course composition- Theory + Practical					
Course Credit	Theory		Practical		Total marks
Theory +Practical	Internal Assessment marks	End term exam marks	Internal Assessment marks	End term exam marks	
1+1	10	20	5	15	50
2+1	15	35	5	15	70
2+2	15	35	15	35	100
3+1	20	50	10	20	100
0+4	NA	NA	30	70	100

1. Internal assessment (30%) shall be broadly based on the following defined components of;

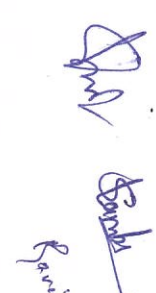
- Class participation
- Seminar/Presentation/Assignment/Quiz/class test, etc.
- Mid Term Exam

Total Internal Assessment Marks (Theory)	Class Participation	Seminar/Presentation/Assignment/Quiz/class test, etc.	Mid-Term Exam
10	4	-	6
15	4	4	7
20	5	5	10
30	5	10	15
Total Internal Assessment Marks (Practicum)	Class Participation	Seminar/Demonstration/Viva-Voce/lab record, etc.	Mid-Term Exam
5	--	5	NA
10	--	10	NA
15	5	10	NA
30	5	10	15

Semester-IV

Course Type Total Credits	Applicable Scheme	Course Code	Nomenclature of the Course	Credits	Contact hours per week	Internal Assessment Marks	End term Examination Marks	Total Marks	Examination Hrs.
CC-4 MCC-6 04 Credits	Scheme A, B, C & D	24UN-CHE-401	Chemistry – IV	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
		24UN-CHE-402	Organic Chemistry – I	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
MCC-7 04 Credits	Scheme B & C	24UN-CHE-403	Physical Chemistry – II	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
		24UN-CHE-404	Elective Chemistry- I	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
DSE-1 04 Credits Select one option	Scheme B & C	OR							
		24UN-CHE-405	Elective Chemistry- II	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
		OR							
		24UN-CHE-406	Elective Chemistry- III	03	03	20	50	70	03
			Practical	01	02	10	20	30	03
		From Available pool of Minor (Vocational) Courses VOC-2							
		From Available pool of Ability Enhancement Courses as per NEP							
		From Available pool of Value Added Courses as per NEP							
		From Available pool of Value Added Courses as per NEP							
CC-M4 (V) 04 Credits	Scheme A, B, C & D	From Available pool of Value Added Courses as per NEP							
VAC-4 02 Credits	Scheme A, B & C	From Available pool of Value Added Courses as per NEP							
VAC-3 02 Credits	Scheme A, B & D	From Available pool of Value Added Courses as per NEP							
VAC-4 02 Credits	Scheme C only	From Available pool of Value Added Courses as per NEP							
Internship 04 Credits	Scheme A, B & C	Internship of 04 Credits of 4-6 weeks duration after 4 th Semester (If not done after 2 nd Semester)							


CC-3|MCC-4

Part A - Introduction			
Subject	Chemistry		
Semester	III		
Name of the Course	Chemistry-III		
Course Code	24UN-CHE-301		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC/MCC		
Level of the course (As per Annexure-I)	200-299		
Pre-requisite for the course (if any)	Chemistry as a subject at 4.0 Level (Class-XII)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. To learn about the structure of S and P-block elements, their properties and discuss their use in daily life as well as industrial applications. 2. To understand about various laws and theories related to electrochemistry-I and know about their thermodynamic properties. 3. To understand about variation of conductance studies with concentration and explain with many phenomenon. 4. The fundamental properties, structures and reactivity of organic compounds such alkene, alkyne arenes, alkyl and aryl halide etc. 5.* Learning about reaction mechanism and predict the outcome of the reactions. 6. How to distinguish between the organic compounds by use of different chemical tests.		
	Theory	Practical	Total
Credits	3	1	4
Contact Hours/week	03	02	05
Internal Assessment Marks	20	10	30
End Term Exam Marks	50	20	70
Examination hrs	03	03	---
Max. Marks: 100 (Theory:70 & Practical: 30)			

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non- programmable calculator is allowed.

Unit	Topics	Contact Hours
I	s and p-Block Elements Salient features of hydrides, oxides, halides, hydroxides of s- block elements (methods of preparation excluded). Structure, preparation and properties of Diborane and Borazine. Structure of oxides of Nitrogen and Phosphorous. Structure of oxyacids of Nitrogen, phosphorous, sulphur and chlorine and comparison of acidic strength of oxyacids. low chemical reactivity of noble gases, structure and bonding in fluorides, oxides and oxyfluorides of xenon.	11
II	Electrochemistry-I Electrolytic conduction, factors affecting electrolytic conduction, specific conductance, molar conductance, equivalent conductance and relation among them, their variation with concentration. Concepts of pH and pK_a , Buffer solution, Buffer action, Henderson – Hazel equation, Buffer mechanism of buffer action. Electrochemistry-II Reversible & irreversible cells, Calculation of thermodynamic quantities of cell reaction (ΔG , ΔH & K). Types of reversible electrodes – metal- metal ion, gas electrode, metal – insoluble salt- anion and redox electrodes. Nernst equation, Standard Hydrogen electrode, calomel electrodes.	11
III	Alkynes Nomenclature and its structure. Methods of formation: using Calcium carbide, dehydrohalogenation, Kolbe's electrolysis. Chemical reactions: Mechanism of electrophilic and nucleophilic addition reactions, formation of metal acetylides, addition of bromine and alkaline $KMnO_4$, ozonolysis. Acidity of alkynes. Stereochemistry of Organic Compounds Concept of isomerism: Structural and Stereoisomerism. Symmetry elements, enantiomers, optical activity, properties of enantiomers, chiral and achiral molecules (up-to 2 asymmetric centres), diastereomers, threo- and erythro- nomenclature, meso-compounds, Relative and absolute configuration, sequence rules, R and S system of nomenclature. Cis- Trans isomerism, E & Z system of nomenclature, Conformational analysis of ethane and n-butane,	11

	conformations of cyclohexane, axial and equatorial bonds. Newman and Sawhorse projection formulae.	
IV	Benzene and its derivatives: Nomenclature, Aromatic nucleus and side chain, Huckels' rule of aromaticity. Aromatic electrophilic substitution, mechanism of nitration, halogenation, sulphonation, and Friedel- Crafts reaction. Energy profile diagrams. Activating, deactivating substituents and orientation. Alkyl halides: Nomenclature, methods of formation: from alkenes and alcohol, nucleophilic substitution reactions of alkyl halides, SN2 and SN1 reactions with energy profile diagrams. Aryl halides: Methods of formation: halogenation, Sandmeyer reaction. The addition-elimination, and the elimination- addition mechanisms of nucleophilic aromatic substitution reactions. Relative reactivities of alkyl halides vs allyl, vinyl, and aryl halides.	12
Practicals		
	Gravimetric Analysis: Estimation of Ni^{2+} as Ni-dimethylglyoxime. Colorimetry: To verify Beer-Lambert law for $\text{KMnO}_4 / \text{K}_2\text{Cr}_2\text{O}_7$ and determine the unknown concentration of the given solution of $\text{KMnO}_4 / \text{K}_2\text{Cr}_2\text{O}_7$ solution. - To prepare acidic and basic buffer solutions of pH 5 and 9 respectively. - Preparation of Cuprous chloride - Preparation of tetra ammine cupric sulphate. - To determine the CST of phenol-water system. - To determine the solubility of Benzoic acid at various temperatures and to determine the ΔH of the dissolution process. - To determine the Enthalpy of neutralisation of strong base Vs strong acid. - To determine the Enthalpy of neutralisation of weak acid Vs. strong base and determine the enthalpy of ionisation of the weak acid. - To determine the Enthalpy of neutralisation of strong acid Vs. weak base and determine the enthalpy of ionisation of the strong acid and determine the enthalpy of ionisation of the strong acid.	30

Suggested Evaluation Methods	
Internal Assessment: ➤ Theory:20 • Class Participation: 5 • Seminar/presentation/ assignment/ quiz/ class test etc.: 5 • Mid-Term Exam: 10 ➤ Practicum:10 • Class Participation: NA • Seminar/ Demonstration/ Viva - voce/ Lab records etc.: 10 • Mid-Term Exam: NA	End Term Examination: ➤ Theory: 50 Written examination ➤ Practicum: 20 Lab record, viva-voce, Demonstration of practical
Part C- Learning Resources	
Recommended Books/e-resources/LMS: 1. Lee, J.D.; (2010), Concise Inorganic Chemistry, Wiley India. 2. Kapoor, K.L. (2015), A Textbook of Physical Chemistry, Vol 1, 6 th Edition, Mc Graw Hill Education. 3. Morrison, R. N.; Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). 4. Finar, I. L. Organic Chemistry (Volume 1& 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education) 5. Solomons, T. W. G.; Fryhle, C. B. ; Snyder, S. A. (2016), Organic Chemistry, 12th Edition, Wiley. 6. Clayden, J.; Greeves, N.; Warren, S. (2012), Organic Chemistry, Oxford. 7. Nasipuri, D. (2018), Stereochemistry of Organic Compounds: Principles and Applications, 3rd Edition, New Age International. 8. Gunstone, F. D. (1975), Guidebook to Stereochemistry, Prentice Hall Press.	

MCC-5

Session: 2024-25			
Part A - Introduction			
Subject	Chemistry		
Semester	III		
Name of the Course	Inorganic Chemistry-I		
Course Code	24UN-CHE-302		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	MCC		
Level of the course (As per Annexure-I)	200-299		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. To learn about the bonding fundamentals for transition elements. 2. To learn on Qualitative ideas of valence bond and bond theories of metallic bond. 3. To learn about general physical properties, reactivities and application of coordination complexes. 4. To get knowledge on General physical properties, reactivities and application of coordination complexes. 5* To learn about on quantitative estimation of Cu^{2+} ions. Also get knowledge to the calculation of ΔH, ΔG and ΔS for dissolving a salts at given temperature.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	03	02	05
Internal assessment Marks	20	10	30
End term Exam Marks	50	20	70
Examination Hrs	03	03	-

Maximum Marks: (Theory: 70 & Practical: 30)

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.

Unit	Topics	Contact Hours
I	Coordination Chemistry: Recapitulation of Werner's Coordination theory. IUPAC nomenclature of coordination Compounds, isomerism in coordination compounds with coordination numbers 4 and 6. A brief idea about chelate effect and labile and inert complexes.	12
II	Valence bond theory and its application to complexes of coordination numbers 4 and 6. Examples of inner and outer orbital complexes, Crystal field theory, measurement of Δ_o . Calculation of CFSE in weak and strong fields, concept of pairing energies, factors affecting the magnitude of Δ_o . Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry Jahn-Teller theorem, square planar geometry. Qualitative aspect of Ligand field and MO Theory (for octahedral σ -donor, π - acceptor and π - donor complexes).	11
III	A brief discussion of differences between the first, second and third transition series. Some important compounds of Cr, Mn, Fe and Co and their roles as laboratory reagents; Potassium dichromate, potassium permanganate, potassium ferrocyanide, potassium ferricyanide, sodium nitroprusside and sodium cobaltinitrite. Lanthanoids and Actinoids: A brief discussion of electronic configuration, oxidation states, colour, spectral and magnetic properties.	11
IV	Inorganic Reaction Mechanism: Introduction to inorganic reaction mechanisms. Concept of reaction pathways, transition state, intermediate and activated complex. Substitution reactions in square planar complexes, Trans- effect, theories of trans-effect.	11

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*Applicable for courses having practical component.

MDC-3

Session: 2024-25			
Part A - Introduction			
Subject	Chemistry		
Semester	III		
Name of the Course	Introductory Chemistry-III		
Course Code	24UN-CHE-MDC301		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	MDC		
Level of the course (As per Annexure-I)	0-99		
Pre-requisite for the course (if any)	Higher secondary other than science discipline		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to:		
	1. To learn about different energy resources. 2. To learn about the purification process of water quality 3. To Know more about Pesticides and their bad impacts on health 4. To get more knowledge on the impacts of pollution on environment 5*. To get acquaint about the pH of different food items.		
Credits	Theory	Practical	Total
	2	1	3
Contact Hours	30	30	60
Max. Marks:50+20* Internal Assessment Marks:15+5* End Term Exam Marks: 35+15*		Time:03+03*	
Part B- Contents of the Course			
Instructions for Paper- Setter			

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.

Also, the candidate may answer either in Hindi or English.

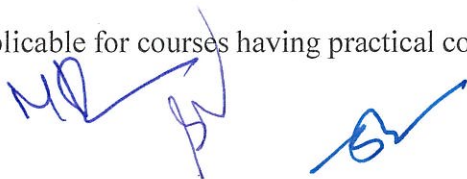
Unit	Topics	Contact Hours
I	Pollution and their types: Plastic and polyethene pollution, pollution sources, Recycling of plastic, greenhouse effect, ozone depletion	8
II	Energy: Energy sources, renewable and non-renewable sources, cells and batteries, fuel cell, solar cell, polymer cell	8
III	Water: Sources of drinking water and uses, water conservation, Permissible TDS, Techniques of purification of water, R.O. water purification process (Osmosis and Reverse Osmosis), wastewater management	7
IV	Pesticides and Herbicides: General introduction and definition, biological control and chemical control: natural and synthetic pesticides, benefits and adverse effects of DDT, BHC, malathion.	7
V*	Practicals: - To check the TDS of different samples of water. - Purify the given sample of water using different purification techniques. - Identify the pH of different samples of food items. - Neutralize the given samples of base using acids	30
Suggested Evaluation Methods		
Internal Assessment: 15 + 5* Theory - Class Participation: 4 - Seminar/presentation/assignment/quiz/class test etc.: 4 - Mid-Term Exam: 7 Practicum - Class Participation: NA - Seminar/Demonstration/Viva-voce/Lab records etc.: 5 - Mid-Term Exam: NA		End Term Examination: 35+15*

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. **Zero Waste: Management Practices for Environmental Sustainability** by Ashok K. Rathoure
2. **Sustainable Solid Waste Management** by Ni-Bin Chang
3. **Handbook of Advanced Industrial and Hazardous Wastes Treatment** by Lawrence K. Wang (Editor); Nazih K. Shammass (Editor); Yung Tse Hung (Editor)
4. **Pesticides and Insecticides, Development and Use**, Bobby Jones|2018
5. **WATER TREATMENT, How To Make Water Safe To Drink**, David Holman
6. **Energy, A Beginner's Guide**, Vaclav Smil, 2017
7. **Advanced Physical Chemistry, Practical Handbook**, Gurdeep Raj, Edition (2016)
8. **Advanced Practical Physical Chemistry, Handbook**, J.B.Yadav, Edition (2016)
9. **Goyal, P K, Water Pollution Causes, Effects and Control** New age International Publishers

*Applicable for courses having practical component.

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VAC-3

Session: 2024-25			
Part A – Introduction			
Subject	Chemistry		
Semester	III		
Name of the Course	Chemistry in everyday life		
Course Code	24UN-CHE-VAC301		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	VAC		
Level of the course (As per Annexure-I)	200-299		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Critically think about the presence of chemicals in daily life 2. Understand presence of chemicals used in food 3. Analyse importance of Vitamins and minerals 4. Think about general medicines 5*. -NA-		
	Theory	Practical	Total
Credits	2	N. A.	2
Contact Hours/week	2	N. A.	2
Internal Assessment Marks	15	N. A.	15
End Term Exam Marks	35	N. A.	35
Examination Time	3hrs		
Maximum Marks: 50			
Part B- Contents of the Course			

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on

entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory.

Unit	Topics	Contact Hours
I	Soaps and detergents, cleansing action of soap, Cleansing action of detergents Propellants, Solid propellant, liquid propellants, hybrid propellants dyes: Cause of exhibition of color, chromophore, auxochrome, classification of dyes Advanced chemical materials: Ceramics, Sunscreens	8 Hrs
II	Chemicals used in foods Preservatives, coloring agents, sweetening agents, flavoring agents, antioxidants Chemicals used to grow, protect foods and crops: Fertilizers, Fungicides, Herbicide and Insecticide etc.	7 Hrs
III	Vitamins and minerals Definition, their significance, Fat soluble vitamins Names, daily dietary requirement, natural sources, Deficiency diseases Water soluble vitamins Names, daily dietary requirement, natural sources, Deficiency diseases Minerals Major and Minor nutrients, daily dietary requirement, natural sources, Deficiency diseases	7 Hrs
IV	Chemicals in Medicine Drug - target interaction (enzymes as drug targets and receptors as drug targets), chemical messengers, types of chemical messengers (hormones and neurotransmitters) Chemotherapy antipyretics, analgesics, antidepressants' antiseptics and disinfectants, antiviral drugs, antacids, antimalarial, anesthetics, tranquilizers, hypnotics and sedatives, ant allergic drugs and histamines	8 Hrs
V*	N.A.	
Suggested Evaluation Methods Short Answer and MCQ Type QUESTIONS		

Internal Assessment: > Theory: 15 ● Class Participation: 04 ● Seminar/presentation/assignment/quiz/class test etc.: 04 ● Mid-Term Exam: 07 > Practicum Nil ● Class Participation: ● Seminar/Demonstration/Viva-voce/Lab records etc.: ● Mid-Term Exam:	End Term Examination: 35
Part C-Learning Resources	
Recommended Books/e-resources/LMS: ✓ NCERT Chemistry	

SEC-3

Part A – Introduction			
Subject	Chemistry		
Semester	III		
Name of the Course	Analytical Chemistry-I		
Course Code	24UN-CHE-SEC301		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	SEC		
Level of the course (As per Annexure-I)	0-99		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Analyse concepts about chromatography & its types; 2. Understand about soil analysis; 3. Learn water purification methods; 4. Perform food processing analysis. 5*. Practically analyse the soil composition.		
	Theory	Practical	Total
Credits	2	1	3
Contact Hours/week	2	2	4
Internal Assessment Marks	15	05	20
End Term Marks	35	20	55
Examination Time	03 Hours	03 Hours	-
Maximum Marks: 75 (Theory : 50 & Practical: 25)			
Part B- Contents of the Course			
<u>Instructions for Paper- Setter</u> Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal			

marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory.

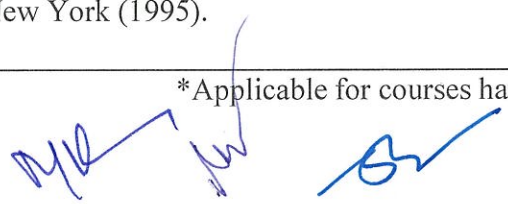
Unit	Topics	Contact Hours
I	Chromatography: Definition, general introduction on principles of chromatography, Column chromatography, paper chromatography, TLC & ion-exchange chromatography.	8 Hrs
II	Analysis of soil: Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators.	7 Hrs
III	Analysis of water: Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods.	8 Hrs
IV	Analysis of food products: Nutritional value of foods, idea about food processing and food preservation and adulteration.	7 Hrs
V*	1. Paper chromatographic separation of mixture of metal ion (Fe^{3+} and Al^{3+}). 2. To compare samples of dyes/paints by TLC method. 3. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc. 4. Determination of pH of soil samples. 5. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration. 6. Determination of pH, acidity and alkalinity of a water	30 Hrs
Suggested Evaluation Methods Short Answer and MCQ Type QUESTIONS		
Internal Assessment: 15 > Theory ● Class Participation: 04 ● Seminar/presentation/assignment/quiz/class test etc.: 04 ● Mid-Term Exam: 07 > Practicum: 05 ● Class Participation: 02 ● Seminar/Demonstration/Viva-voce/Lab records etc.: 03 ● Mid-Term Exam: NIL		End Term Examination: 35+20*

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- ✓ E. Stocchi: *Industrial Chemistry*, Vol -I, Ellis Horwood Ltd. UK.
- ✓ Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*. 7th Ed. Wadsworth Publishing Co. Ltd., Belmont, California, USA, 1988.
- ✓ Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
- ✓ Skoog, D.A.; West, D.M. & Holler, F.J. *Fundamentals of Analytical Chemistry* 6th Ed., Saunders College Publishing, Fort Worth (1992).
- ✓ Harris, D. C. *Quantitative Chemical Analysis*, W. H. Freeman.
- ✓ Dean, J. A. *Analytical Chemistry Notebook*, McGraw Hill.
- ✓ Day, R. A. & Underwood, A. L. *Quantitative Analysis*, Prentice Hall of India.
- ✓ Freifelder, D. *Physical Biochemistry* 2nd Ed., W.H. Freeman and Co., N.Y. USA (1982).
- ✓ Cooper, T.G. *The Tools of Biochemistry*, John Wiley and Sons, N.Y. USA. 16 (1977).
- ✓ Vogel, A. I. *Vogel's Qualitative Inorganic Analysis* 7th Ed., Prentice Hall.
- ✓ Vogel, A. I. *Vogel's Quantitative Chemical Analysis* 6th Ed., Prentice Hall.
- ✓ Robinson, J.W. *Undergraduate Instrumental Analysis* 5th Ed., Marcel Dekker, Inc., New York (1995).

*Applicable for courses having practical component



CC-M3(V) or CC-M5(V)

Session: 2024-25			
Part A – Introduction			
Subject	Chemistry		
Semester	III		
Name of the Course	Chemistry of Fertilizers and Pesticides		
Course Code	24UN-CHE-VOC-1		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	VOC		
Level of the course (As per Annexure-I)	200-299		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Know about fertilizers and nutrients; 2. Understand types of nitrate fertilizers; 3. Understand types of phosphate fertilizers; 4. Get the knowledge about pesticides. 5*. Understand the issues involved in pesticides and fertilizers		
	Theory	Practical	Total
Credits	3	1	4
Contact Hours/week	3	2	5
Internal Assessment Marks	20	10	30
End Term Marks	50	20	70
Examination Time	3hrs	3hrs	
Maximum Marks: 100 (Theory: 70 & Practical : 30)			
Part B- Contents of the Course			

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal

marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory.

Unit	Topics	Contact Hours
I	Methods and time of fertilizer applications, tips to get best efficiency of Applied fertilizers, Integrated nutrient management, fertilizers and its relations to plant nutrients, Factors effecting optimum fertilizer dose.	12 Hrs
II	Classification and types of fertilizers, Nitrogenous fertilizers: Ammonium nitrate, Urea, Calcium Cyanamide, Calcium Ammonium Nitrate, Sodium Nitrate, Ammonium Chloride: Introduction, Raw materials, Action of as a fertilizers.	11Hrs
III	Phosphate fertilizers: Normal super phosphate, Triple Super Phosphate, Ammonium Phosphate. Potassic fertilizers (Types and optimum doses)	11Hrs
IV	pesticides: Classification, synthesis, structure activity relationship (SAR), mode of action, uses and adverse effects of representative pesticides in the following classes: Organochlorines (DDT, Gammaxene); Organophosphates (Malathion, Parathion); Carbamates (Carbofuran and Carbaryl); Quinones (Chloranil), Anilides (Alachlor and Butachlor).	11Hrs
V*	1. To carryout market survey of potent pesticides with details as follows: a) Name of pesticide b) Chemical name, class and structure of pesticide c) Type of formulation available and Manufacturer's name d) Useful information on label of packaging regarding: Toxicity, LD50 ("Lethal Dose, 50%"), Side effects and Antidotes. 2. To carryout market survey of potent botanical pesticides with details as follows: a) Botanical name and family; b) Chemical name (active ingredient) and structure of active ingredient; c) Type of formulation available and Manufacturer's name; d) Useful information on label of packaging regarding: Toxicity, LD50 ("Lethal Dose, 50%"), Side effects and Antidotes. 3. Preparation of simple Organochlorine pesticides. 4. To calculate acidity/alkalinity in given sample of pesticide formulations as per BIS specifications.	30 Hrs
	5. To calculate active ingredient in given sample of pesticide formulations as per BIS specifications. 6. Preparation of Neem based botanical pesticides. 7. To study about identification of crops, seeds, fertilizers and pesticides.	

Suggested Evaluation Methods
Short Answer and MCQ Type QUESTIONS

Internal Assessment: 20+10*=30

➤ **Theory: 20**

- Class Participation: 05
- Seminar/presentation/assignment/quiz/class test etc.:05
- Mid-Term Exam: 10

➤ **Practicum:10**

- Class Participation: 05
- Seminar/Demonstration/Viva-voce/Lab records etc.: 05
- Mid-Term Exam: N. A.

**End Term
Examination: 50+20***

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- ✓ Gopal Rao: Outlines in Chemical Technology.
- ✓ Shukla and Pandey: Introduction to Chemical Technology
- ✓ Perry, A.S.; Yamamoto, I.; Ishaaya, I.; Perry, R.Y.(1998), Insecticides in Agriculture and Environment, Springer-Verlag Berlin Heidelberg.
- ✓ Kuhr, R.J. ; Derough, H.W.(1976), Carbamate Insecticides: Chemistry, Biochemistry and Toxicology, CRC Press, USA.

MCC-2

Session: 2023-24

Part A - Introduction

Subject	Chemistry		
Semester	I		
Name of the Course	Physical Chemistry-I		
Course Code	24UN-CHE-102		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VA C)	MCC		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	Chemistry as a subject at 4.0 Level (Class-XII)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Get the knowledge of concepts of rates of chemical reactions and its application in determination of order of various reactions. 2. Get the knowledge of various thermodynamic variables and properties. 3. To learn about the concepts of physical and thermodynamic functions in different reversible reactions and get the knowledge of molecular structure. 4. To learn about the various properties of molecules related to its magnetic behavior. 5. Hand on practice in preparation of solutions, compounds, estimation and determination of physical properties of some compounds.		
	Theory	Practical	Total
Credits	3	1	4
Contact Hours/week	03	02	05
Internal Assessment Marks	20	10	30
End Term Exam Marks	50	20	70
Examination hrs	03	03	---

Part B- Contents of the Course

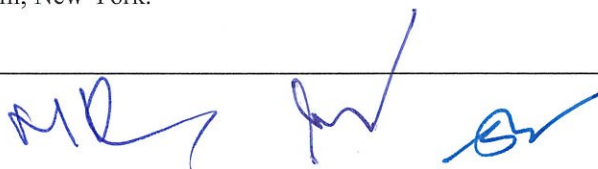
Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non- programmable calculator is allowed.

Unit	Topics	Contact Hours
I	Chemical Kinetics: Kinetics Rate of reaction, rate equation and its types, factors influencing the rate of a reaction – concentration, temperature, pressure, solvent, light, catalyst. Order and molecularity of a reaction, integrated rate expression for zero order, first order, second and third order reactions (for equal and unequal concentrations of reactants), methods of determination of order of reaction, Half-life period of a reaction. Effect of temperature on the rate of reaction – Arrhenius equation.	12
II	Chemical Kinetics & Thermodynamics: Theories of reaction rate – Simple collision theory for unimolecular collision. Transition state theory of bimolecular reactions. Definition of thermodynamic terms: system, surrounding etc. Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamic process. Thermodynamic equilibrium, Concept of heat and work. First law of thermodynamics: statement, concepts of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship.	11
III	Thermodynamics, Physical Properties and Molecular Structure-I: Joule–Thomson coefficient for ideal gas and real gas and inversion temperature. Calculation of w , q , dU & dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process. Optical activity, polarization – (Clausius – Mossotti equation-derivation excluded). Orientation of dipoles in an electric field, dipole moment, induced dipole moment.	11
IV	Physical Properties and Molecular Structure-II: Measurement of dipole moment-temperature method and refractivity method, dipole moment and structure of molecules, Magnetic permeability, magnetic susceptibility and its determination. Application of magnetic susceptibility, magnetic properties – paramagnetism, diamagnetism and ferromagnetism.	11
Practical		
	1. Acid/Base titration: Determination of strength of HCl using NaOH. 2. Redox titrations: Determination of $C_2O_4^{2-}$ ions using $KMnO_4$. 3. To determine the surface tension of given liquid using Stalagmometer by drop weight methods. 4. To study the effect of surfactant on surface tension of water. 5. To study the process of sublimation of Camphor and Phthalic acid.	30
Suggested Evaluation Methods		
Internal Assessment > Theory: 20 - Class Participation: 5 - Seminar/presentation/assignment/quiz/class test etc.: 5 - Mid-Term Exam: 10 > Practicum: 10 - Class Participation: NA - Seminar/Demonstration/ Viva -voce/ Lab records etc.: 10 - Mid-Term Exam: NA		End Term Examination: > Theory: 50 Written examination > Practicum: 20 Lab record, viva-voce, Demonstration of practical
Part C- Learning Resources		

Recommended Books/e-resources/LMS:

1. Atkins, P.W.; Paula, J.de. (2014), **Atkin's Physical Chemistry Ed.**, 10th Edition, Oxford University Press.
2. Ball, D. W. (2017), **Physical Chemistry**, 2 nd Edition, Cengage Learning, India.
3. Castellan, G. W. (2004), **Physical Chemistry**, 4 th Edition, Narosa.
4. Kapoor, K.L. (2015), **A Textbook of Physical Chemistry**, Vol 1, 6 th Edition, McGraw Hill Education.
5. Khosla, B.D.; Garg, V.C.; Gulati, A. (2015), **Senior Practical Physical Chemistry**, R. Chand & Co, New Delhi.
6. Garland, C. W.; Nibler, J. W.; Shoemaker, D. P. (2003), **Experiments in Physical Chemistry**, 8 th Edition, McGraw-Hill, New York.



CC-3/MCC-4

Session: 2024-25			
Part A - Introduction			
Subject	Chemistry		
Semester	III		
Name of the Course	Chemistry-III		
Course Code	24UN-CHE-301		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC/MCC		
Level of the course (As per Annexure-I)	200-299		
Pre-requisite for the course (if any)	Chemistry as a subject at 4.0 Level (Class-XII)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. To learn about the structure of S and P-block elements, their properties and discuss their use in daily life as well as industrial applications. 2. To understand about various laws and theories related to electrochemistry-I and know about their thermodynamic properties. 3. To understand about variation of conductance studies with concentration and explain with many phenomenon. 4. The fundamental properties, structures and reactivity of organic compounds such alkene, alkyne arenes, alkyl and aryl halide etc. 5. * Learning about reaction mechanism and predict the outcome of the reactions. 6. How to distinguish between the organic compounds by use of different chemical tests.		
	Theory	Practical	Total
Credits	3	1	4
Contact Hours/week	03	02	05

W Ravi Kant

or

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Gambh

Shruti

Nil

Internal Assessment Marks	20	10	30
End Term Exam Marks	50	20	70
Examination hrs	03	03	---
Max. Marks: 100 (Theory:70 & Practical: 30)			

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non- programmable calculator is allowed.

Unit	Topics	Contact Hours
I	s and p-Block Elements Salient features of hydrides, oxides, halides, hydroxides of s- block elements (methods of preparation excluded). Structure, preparation and properties of Diborane and Borazine. Structure of oxides of Nitrogen and Phosphorous. Structure of oxyacids of Nitrogen, phosphorous, sulphur and chlorine and comparison of acidic strength of oxyacids. low chemical reactivity of noble gases, structure and bonding in fluorides, oxides and oxyfluorides of xenon.	11
II	Electrochemistry-I Electrolytic conduction, factors affecting electrolytic conduction, specific conductance, molar conductance, equivalent conductance and relation among them, their variation with concentration. Concepts of pH and pK _a , Buffer solution, Buffer action, Henderson – Hazel equation, Buffer mechanism of buffer action. Electrochemistry-II Reversible & irreversible cells, Calculation of thermodynamic quantities of cell reaction (ΔG , ΔH & K). Types of reversible electrodes – metal- metal ion, gas electrode, metal – insoluble salt- anion and redox electrodes. Nernst equation, Standard Hydrogen electrode, calomel electrodes.	11
III	Alkynes Nomenclature and its structure. Methods of formation: using Calcium carbide, dehydrohalogenation, Kolbe's electrolysis. Chemical reactions: Mechanism of electrophilic and nucleophilic addition reactions, formation of metal acetylides, addition of bromine and alkaline KMnO ₄ , ozonolysis. Acidity of alkynes. Stereochemistry of Organic Compounds Concept of isomerism: Structural and Stereoisomerism. Symmetry	11

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	elements, enantiomers, optical activity, properties of enantiomers, chiral and achiral molecules (up-to 2 asymmetric centres), diastereomers, threo- and erythro- nomenclature, meso-compounds, Relative and absolute configuration, sequence rules, R and S system of nomenclature. Cis- Trans isomerism, E & Z system of nomenclature, Conformational analysis of ethane and n-butane, conformations of cyclohexane, axial and equatorial bonds. Newman and Sawhorse projection formulae.	
IV	Benzene and its derivatives: Nomenclature, Aromatic nucleus and side chain, Huckels' rule of aromaticity. Aromatic electrophilic substitution, mechanism of nitration, halogenation, sulphonation, and Friedel- Crafts reaction. Energy profile diagrams. Activating, deactivating substituents and orientation. Alkyl halides: Nomenclature, methods of formation: from alkenes and alcohol, nucleophilic substitution reactions of alkyl halides, SN2 and SN1 reactions with energy profile diagrams. Aryl halides: Methods of formation: halogenation, Sandmeyer reaction. The addition-elimination, and the elimination- addition mechanisms of nucleophilic aromatic substitution reactions. Relative reactivities of alkyl halides vs allyl, vinyl, and aryl halides.	12
Practicals		
	Gravimetric Analysis: Estimation of Ni^{2+} as Ni-dimethylglyoxime. Colorimetry: To verify Beer-Lambert law for KMnO_4 / $\text{K}_2\text{Cr}_2\text{O}_7$ and determine the unknown concentration of the given solution of KMnO_4 / $\text{K}_2\text{Cr}_2\text{O}_7$ solution. - To prepare acidic and basic buffer solutions of pH 5 and 9 respectively. - Preparation of Cuprous chloride - Preparation of tetra ammine cupric sulphate. - To determine the CST of phenol-water system. - To determine the solubility of Benzoic acid at various temperatures and to determine the ΔH of the dissolution process. - To determine the Enthalpy of neutralisation of strong base Vs strong acid. - To determine the Enthalpy of neutralisation of weak acid Vs. strong base and determine the enthalpy of ionisation of the weak acid. - To determine the Enthalpy of neutralisation of strong acid Vs. weak base and determine the enthalpy of ionisation of the	30

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	strong acid and determine the enthalpy of ionisation of the strong acid.	
Suggested Evaluation Methods		
Internal Assessment: ➤ Theory:20 • Class Participation: 5 • Seminar/presentation/ assignment/ quiz/ class test etc.: 5 • Mid-Term Exam: 10 ➤ Practicum:10 • Class Participation: NA • Seminar/ Demonstration/ Viva - voce/ Lab records etc.: 10 • Mid-Term Exam: NA		End Term Examination: ➤ Theory: 50 Written examination ➤ Practicum: 20 Lab record, viva-voce, Demonstration of practical
Part C- Learning Resources		
Recommended Books/e-resources/LMS: 1. Lee, J.D.; (2010), Concise Inorganic Chemistry, Wiley India. 2. Kapoor, K.L. (2015), A Textbook of Physical Chemistry, Vol 1, 6 th Edition, Mc Graw Hill Education. 3. Morrison, R. N.; Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). 4. Finar, I. L. Organic Chemistry (Volume 1& 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education) 5. Solomons, T. W. G.; Fryhle, C. B. ; Snyder, S. A. (2016), Organic Chemistry, 12th Edition, Wiley. 6. Clayden, J.; Greeves, N.; Warren, S. (2012), Organic Chemistry, Oxford. 7. Nasipuri, D. (2018), Stereochemistry of Organic Compounds: Principles and Applications, 3rd Edition, New Age International. 8. Gunstone, F. D. (1975), Guidebook to Stereochemistry, Prentice Hall Press.		

MCC-5

Session: 2024-25			
Part A - Introduction			
Subject	Chemistry		
Semester	III		
Name of the Course	Inorganic Chemistry-I		
Course Code	24UN-CHE-302		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VA C)	MCC		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. To learn about the bonding fundamentals for transition elements. 2. To learn on Qualitative ideas of valence bond and bond theories of metallic bond. 3. To learn about general physical properties, reactivities and application of coordination complexes. 4. To get knowledge on General physical properties, reactivities and application of coordination complexes. 5* To learn about on quantitative estimation of Cu^{2+} ions. Also get knowledge to the calculation of ΔH, ΔG and ΔS for dissolving a salts at given temperature.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	03	02	05
Internal assessment Marks	20	10	30
End term Exam Marks	50	20	70
Examination Hrs	03	03	-

Maximum Marks: (Theory: 70 & Practical: 30)

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.

Unit	Topics	Contact Hours
I	Coordination Chemistry: Recapitulation of Werner's Coordination theory. IUPAC nomenclature of coordination Compounds, isomerism in coordination compounds with coordination numbers 4 and 6. A brief idea about chelate effect and labile and inert complexes.	12
II	Valence bond theory and its application to complexes of coordination numbers 4 and 6. Examples of inner and outer orbital complexes, Crystal field theory, measurement of Δ_o . Calculation of CFSE in weak and strong fields, concept of pairing energies, factors affecting the magnitude of Δ_o . Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry Jahn-Teller theorem, square planar geometry. Qualitative aspect of Ligand field and MO Theory (for octahedral σ -donor, π - acceptor and π - donor complexes).	11
III	A brief discussion of differences between the first, second and third transition series. Some important compounds of Cr, Mn, Fe and Co and their roles as laboratory reagents; Potassium dichromate, potassium permanganate, potassium ferrocyanide, potassium ferricyanide, sodium nitroprusside and sodium cobaltinitrite. Lanthanoids and Actinoids: A brief discussion of electronic configuration, oxidation states, colour, spectral and magnetic properties.	11
IV	Inorganic Reaction Mechanism: Introduction to inorganic reaction mechanisms. Concept of reaction pathways, transition state, intermediate and activated complex. Substitution reactions in square planar complexes, Trans- effect, theories of trans-effect.	11

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*Applicable for courses having practical component.

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MDC-3

Session: 2024-25			
Part A - Introduction			
Subject	Chemistry		
Semester	III		
Name of the Course	Introductory Chemistry-III		
Course Code	24-UN-CHE301		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VA C)	MDC		
Level of the course (As per Annexure-I	0-99		
Pre-requisite for the course (if any)	Higher secondary other than science discipline		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to:		
	1. To learn about different energy resources. 2. To learn about the purification process of water quality 3. To Know more about Pesticides and their bad impacts on health 4. To get more knowledge on the impacts of pollution on environment 5*. To get acquaint about the pH of different food items.		
Credits	Theory	Practical	Total
	2	1	3
Contact Hours	30	30	60
Max. Marks:50+20* Internal Assessment Marks:15+5* End Term Exam Marks: 35+15*		Time:03+03*	
Part B- Contents of the Course			
Instructions for Paper- Setter			

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.

Also, the candidate may answer either in Hindi or English.

Unit	Topics	Contact Hours
I	Pollution and their types: Plastic and polyethene pollution, pollution sources, Recycling of plastic, greenhouse effect, ozone depletion	8
II	Energy: Energy sources, renewable and non-renewable sources, cells and batteries, fuel cell, solar cell, polymer cell	8
III	Water: Sources of drinking water and uses, water conservation, Permissible TDS, Techniques of purification of water, R.O. water purification process (Osmosis and Reverse Osmosis), wastewater management	7
IV	Pesticides and Herbicides: General introduction and definition, biological control and chemical control: natural and synthetic pesticides, benefits and adverse effects of DDT, BHC, malathion.	7
V*	Practicals: 1. To check the TDS of different samples of water. 2. Purify the given sample of water using different purification techniques. 3. Identify the pH of different samples of food items. 4. Neutralize the given samples of base using acids	30

Suggested Evaluation Methods

Internal Assessment: 15 + 5* Theory • Class Participation: 4 • Seminar/presentation/assignment/quiz/class test etc.: 4 • Mid-Term Exam: 7 Practicum • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 5 • Mid-Term Exam: NA	End Term Examination: 35+15*
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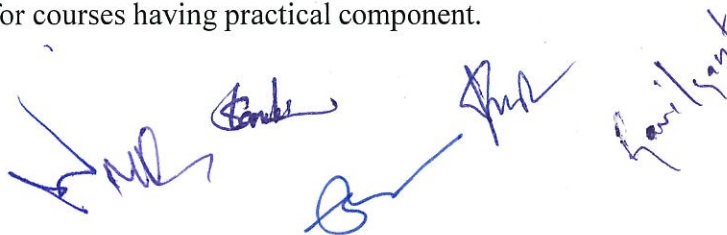
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Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. **Zero Waste: Management Practices for Environmental Sustainability** by Ashok K. Rathoure
2. **Sustainable Solid Waste Management** by Ni-Bin Chang
3. **Handbook of Advanced Industrial and Hazardous Wastes Treatment** by Lawrence K. Wang (Editor); Nazih K. Shammass (Editor); Yung Tse Hung (Editor)
4. **Pesticides and Insecticides, Development and Use**, Bobby Jones|2018
5. **WATER TREATMENT, How To Make Water Safe To Drink**, David Holman
6. **Energy, A Beginner's Guide**, Vaclav Smil, 2017
7. **Advanced Physical Chemistry, Practical Handbook**, Gurdeep Raj, Edition (2016)
8. **Advanced Practical Physical Chemistry, Handbook**, J.B. Yadav, Edition (2016)
9. **Goyal, P K, Water Pollution Causes, Effects and Control** New age International Publishers

*Applicable for courses having practical component.



VAC-3

Session: 2024-25

Part A – Introduction

Subject	Chemistry		
Semester	III & IV		
Name of the Course	Chemistry in everyday life		
Course Code	24UN-CHE-VAC301		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	VAC		
Level of the course (As per Annexure-I)	200-299		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Critically think about the presence of chemicals in daily life 2. Understand presence of chemicals used in food 3. Analyse importance of Vitamins and minerals 4. Think about general medicines 5*. -NA-		
	Theory	Practical	Total
Credits	2	N. A.	2
Contact Hours/week	2	N. A.	2
Internal Assessment Marks	15	N. A.	15
End Term Exam Marks	35	N. A.	35
Examination Time	3hrs		
Maximum Marks: 50			
Part B- Contents of the Course			

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Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on

entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory.

Unit	Topics	Contact Hours
I	Soaps and detergents, cleansing action of soap, Cleansing action of detergents Propellants, Solid propellant, liquid propellants, hybrid propellants dyes: Cause of exhibition of color, chromophore, auxochrome, classification of dyes Advanced chemical materials: Ceramics, Sunscreens	8 Hrs
II	Chemicals used in foods Preservatives, coloring agents, sweetening agents, flavoring agents, antioxidants Chemicals used to grow, protect foods and crops: Fertilizers, Fungicides, Herbicide and Insecticide etc.	7 Hrs
III	Vitamins and minerals Definition, their significance, Fat soluble vitamins Names, daily dietary requirement, natural sources, Deficiency diseases Water soluble vitamins Names, daily dietary requirement, natural sources, Deficiency diseases Minerals Major and Minor nutrients, daily dietary requirement, natural sources, Deficiency diseases	7 Hrs
IV	Chemicals in Medicine Drug - target interaction (enzymes as drug targets and receptors as drug targets), chemical messengers, types of chemical messengers (hormones and neurotransmitters) Chemotherapy antipyretics, analgesics, antidepressants' antiseptics and disinfectants, antiviral drugs, antacids, antimalarial, anesthetics, tranquilizers, hypnotics and sedatives, ant allergic drugs and histamines	8 Hrs
V*	N.A.	
Suggested Evaluation Methods Short Answer and MCQ Type QUESTIONS		

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Internal Assessment: ➤ Theory: 15 ● Class Participation: 04 ● Seminar/presentation/assignment/quiz/class test etc.: 04 ● Mid-Term Exam: 07 ➤ Practicum Nil ● Class Participation: ● Seminar/Demonstration/Viva-voce/Lab records etc.: ● Mid-Term Exam:	End Term Examination: 35
Part C-Learning Resources	
Recommended Books/e-resources/LMS: ✓ NCERT Chemistry	

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VAC-4

Session: 2024-25			
Part A – Introduction			
Subject	Chemistry		
Semester	IV		
Name of the Course	Agricultural Chemistry		
Course Code	24UNCHE-VAC401		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	VAC		
Level of the course (As per Annexure-I)	100-999		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1 Thinks about chemistry involved in agriculture 2 Know about chemical composition of soils; 3 Understand impacts of pollutions on soils and its productivity; 4 Critically think regarding sewage effluents. 5*. N.A.		
	Theory	Practical	Total
Credits	2	N.A.	2
Contact Hours per week	2	N.A.	2
Internal Assessment Marks	15	N. A.	15
End Term Exam Marks	35	N. A.	35
Examination Time	3hrs		
Maximum Marks: 50			
Part B- Contents of the Course			

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal

marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory.

Unit	Topics	Contact Hours
I	Plants as producers: Photosynthesis, pesticides, herbicide, insecticide, fungicide, storage and preservation of agriculture produce, food processing.	8 Hrs
II	Soil fertility and soil productivity: urea cycle, Organic and inorganic nitrogen (Haber Bosch Process), nutrient sources – fertilizers and manures; essential plant nutrients - functions and deficiency symptoms, Introduction of Micronutrient	7 Hrs
III	Chemical (elemental) composition of the earth's crust and soils, Chemistry of acid soils; active and potential acidity; lime potential, chemistry of acid soils; sub-soil acidity; Chemistry of salt-affected soils and amendments; soil pH	7 Hrs
IV	Nature and sources of pollutants acid rains, oil spills etc.; air, water and soil pollutants - and effect on plants, animals and human beings. Sewage and industrial effluents – their composition and effect on soil properties/health, and plant growth and human beings; soil as sink for waste disposal.	8 Hrs
V*	N.A.	

Suggested Evaluation Methods
Short Answer and MCQ Type QUESTIONS

Internal Assessment:

➤ **Theory: 15**

- Class Participation: 04
- Seminar/presentation/assignment/quiz/class test etc.: 04
- Mid-Term Exam: 07

➤ **Practicum Nil**

End Term Examination:
35

Part C-Learning Resources

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Recommended Books/e-resources/LMS:

- ✓ Bear RE. 1964. Chemistry of the Soil. Oxford and IBH. Bolt GH & Bruggenwert MGM. 1978. Soil Chemistry. Elsevier. Greenland DJ & Hayes MHB. 1981. Chemistry of Soil Processes. John Wiley & Sons.
- ✓ Brady NC & Weil RR. 2002. The Nature and Properties of Soils. 13 Ed. Pearson Edu.
- ✓ Kabata-Pendias A & Pendias H. 1992. Trace Elements in Soils and Plants. CRC Press.
- ✓ Kannaiyan S, Kumar K & Govindarajan K. 2004. Biofertilizers Technology. Scientific Publ.
- ✓ Leigh JG. 2002. Nitrogen Fixation at the Millennium. Elsevier.
- ✓ Mengel K & Kirkby EA. 1982. Principles of Plant Nutrition. International Potash Institute, Switzerland.
- ✓ Mortvedt JJ, Shuman LM, Cox FR & Welch RM. 1991. Micronutrients in nd Agriculture. 2 Ed. SSSA, Madison.
- ✓ Pierzinsky GM, Sims TJ & Vance JF. 2002. Soils and Environmental nd Quality. 2 Ed. CRC Press.
- ✓ Stevenson FJ & Cole MA. 1999. Cycles of Soil: Carbon, Nitrogen, Phosphorus, Sulphur, Micronutrients. John Wiley & Sons.
- ✓ Tisdale SL, Nelson SL, Beaton JD & Havlin JL. 1999. Soil Fertility and th Fertilizers. 5 Ed. Prentice Hall of India.
- ✓ Troeh FR & Thompson LM. 2005. Soils and Soil Fertility. Blackwell.

*Applicable for courses having practical component.

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SEC-3

Session: 2024-25			
Part A – Introduction			
Subject	Chemistry		
Semester	III		
Name of the Course	Analytical Chemistry-I		
Course Code	24UN-CHE-SEC301		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	SEC		
Level of the course (As per Annexure-I)	0-99		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Analyse concepts about chromatography & its types; 2. Understand about soil analysis; 3. Learn water purification methods; 4. Perform food processing analysis. 5*. Practically analyse the soil composition.		
	Theory	Practical	Total
Credits	2	1	3
Contact Hours/week	2	2	4
Internal Assessment Marks	15	05	20
End Term Marks	35	20	55
Examination Time	03 Hours	03 Hours	-
Maximum Marks: 75 (Theory : 50 & Practical: 25)			
Part B- Contents of the Course			

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Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory.

Unit	Topics	Contact Hours
I	Chromatography: Definition, general introduction on principles of chromatography, Column chromatography, paper chromatography, TLC & ion-exchange chromatography.	8 Hrs
II	Analysis of soil: Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators.	7 Hrs
III	Analysis of water: Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods.	8 Hrs
IV	Analysis of food products: Nutritional value of foods, idea about food processing and food preservations and adulteration.	7 Hrs
V*	1. Paper chromatographic separation of mixture of metal ion (Fe^{3+} and Al^{3+}). 2. To compare samples of dyes/paints by TLC method. 3. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc. 4. Determination of pH of soil samples. 5. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration. 6. Determination of pH, acidity and alkalinity of a water	30 Hrs
Suggested Evaluation Methods Short Answer and MCQ Type QUESTIONS		

Internal Assessment: 15 ➤ Theory • Class Participation: 04 • Seminar/presentation/assignment/quiz/class test etc.: 04 • Mid-Term Exam: 07 ➤ Practicum: 05 • Class Participation: 02 • Seminar/Demonstration/Viva-voce/Lab records etc.: 03 • Mid-Term Exam: NIL	End Term Examination: 35+20*
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Part C-Learning Resources

Recommended Books/e-resources/LMS:

- ✓ E. Stocchi: *Industrial Chemistry*, Vol -I, Ellis Horwood Ltd. UK.
- ✓ Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*. 7th Ed. Wadsworth Publishing Co. Ltd., Belmont, California, USA, 1988.
- ✓ Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
- ✓ Skoog, D.A.; West, D.M. & Holler, F.J. *Fundamentals of Analytical Chemistry* 6th Ed., Saunders College Publishing, Fort Worth (1992).
- ✓ Harris, D. C. *Quantitative Chemical Analysis*, W. H. Freeman.
- ✓ Dean, J. A. *Analytical Chemistry Notebook*, McGraw Hill.
- ✓ Day, R. A. & Underwood, A. L. *Quantitative Analysis*, Prentice Hall of India.
- ✓ Freifelder, D. *Physical Biochemistry* 2nd Ed., W.H. Freeman and Co., N.Y. USA (1982).
- ✓ Cooper, T.G. *The Tools of Biochemistry*, John Wiley and Sons, N.Y. USA. 16 (1977).
- ✓ Vogel, A. I. *Vogel's Qualitative Inorganic Analysis* 7th Ed. Prentice Hall

*Applicable for courses having practical component

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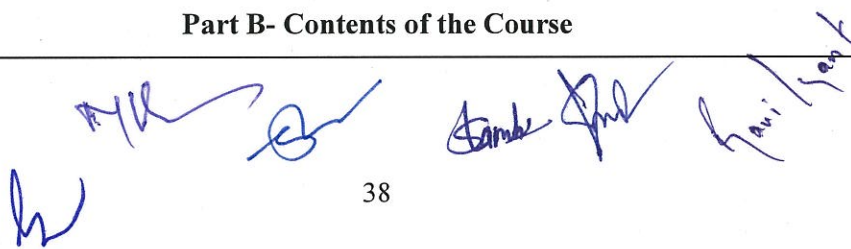
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CC-M3(V) or CC-M5(V)

Session: 2024-25			
Part A – Introduction			
Subject	Chemistry		
Semester	III & Vth Semester		
Name of the Course	Chemistry of Fertilizers and Pesticides		
Course Code	24UN-CHE-VOC-1		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	VOC		
Level of the course (As per Annexure-I)	200-299		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Know about fertilizers and nutrients; 2. Understand types of nitrate fertilizers; 3. Understand types of phosphate fertilizers; 4. Get the knowledge about pesticides. 5*. Understand the issues involved in pesticides and fertilizers		
	Theory	Practical	Total
Credits	3	1	4
Contact Hours/week	3	2	5
Internal Assessment Marks	20	10	30
End Term Marks	50	20	70
Examination Time	3hrs	3hrs	
Maximum Marks: 100 (Theory: 70 & Practical : 30)			
Part B- Contents of the Course			



Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal

marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory.

Unit	Topics	Contact Hours
I	Methods and time of fertilizer applications, tips to get best efficiency of Applied fertilizers, Integrated nutrient management, fertilizers and its relations to plant nutrients, Factors effecting optimum fertilizer dose.	12 Hrs
II	Classification and types of fertilizers, Nitrogenous fertilizers: Ammonium nitrate, Urea, Calcium Cyanamide, Calcium Ammonium Nitrate, Sodium Nitrate, Ammonium Chloride: Introduction, Raw materials, Action of as a fertilizers.	11Hrs
III	Phosphate fertilizers: Normal super phosphate, Triple Super Phosphate, Ammonium Phosphate. Potassic fertilizers (Types and optimum doses)	11Hrs
IV	pesticides: Classification, synthesis, structure activity relationship (SAR), mode of action, uses and adverse effects of representative pesticides in the following classes: Organochlorines (DDT, Gammaxene); Organophosphates (Malathion, Parathion); Carbamates (Carbofuran and Carbaryl); Quinones (Chloranil), Anilides (Alachlor and Butachlor).	11Hrs

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V*	- To carryout market survey of potent pesticides with details as follows: a) Name of pesticide b) Chemical name, class and structure of pesticide c) Type of formulation available and Manufacturer's name d) Useful information on label of packaging regarding: Toxicity, LD50 ("Lethal Dose, 50%"), Side effects and Antidotes. - To carryout market survey of potent botanical pesticides with details as follows: a) Botanical name and family; b) Chemical name (active ingredient) and structure of active ingredient; c) Type of formulation available and Manufacturer's name; d) Useful information on label of packaging regarding: Toxicity, LD50 ("Lethal Dose, 50%"), Side effects and Antidotes. - Preparation of simple Organochlorine pesticides. - To calculate acidity/alkalinity in given sample of pesticide formulations as per BIS specifications. - To calculate active ingredient in given sample of pesticide formulations as per BIS specifications. - Preparation of Neem based botanical pesticides. - To study about identification of crops, seeds, fertilizers and pesticides.	30 Hrs
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Suggested Evaluation Methods Short Answer and MCQ Type QUESTIONS	
Internal Assessment: 20+10*=30 > Theory: 20 - Class Participation: 05 - Seminar/presentation/assignment/quiz/class test etc.:05 - Mid-Term Exam: 10 > Practicum:10 - Class Participation: 05 - Seminar/Demonstration/Viva-voce/Lab records etc.: 05 - Mid-Term Exam: N. A.	End Term Examination: 50+20*
Part C-Learning Resources	
Recommended Books/e-resources/LMS: ✓ Gopal Rao: Outlines in Chemical Technology. ✓ Shukla and Pandey: Introduction to Chemical Technology ✓ Perry, A.S.; Yamamoto, I.; Ishaaya, I.; Perry, R.Y.(1998), Insecticides in Agriculture and Environment, Springer-Verlag Berlin Heidelberg. ✓ Kuhr, R.J. ; Derough, H.W.(1976), Carbamate Insecticides: Chemistry, Biochemistry and Toxicology, CRC Press, USA.	

CC-4/MCC-6

Session: 2024-25			
Part A - Introduction			
Subject	Chemistry		
Semester	IV		
Name of the Course	Chemistry-IV		
Course Code	21UN-CHE-401		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC/MCC		
Level of the course (As per Annexure-I)	200-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Classify d block and f block elements and also know their properties 2. Learn about the basic idea of analysis with respect to qualitative as well as quantitative measures 3. Know about the first and second law of thermodynamics and also their implications and also know about the concept of chemical equilibrium 4. Know about the alcohols, phenols, aldehydes and ketones with respect to their general characteristics and their important reactions 5*. To get knowledge about identification and confirmation of acidic and basic radicals in a given inorganic salts/mixtures		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75

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Max. Marks:70+30*

Internal Assessment Marks:20+10*

End Term Exam Marks: 50+20*

Time:03+03*

Part B- Contents of the Course

Instructions for Paper- Setter

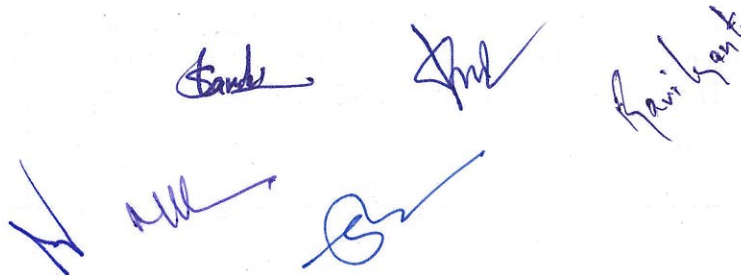
Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.

Unit	Topics	Contact Hours
I	Chemistry of d-Block elements Definition of transition elements, General characteristic properties of d-Block elements, Comparison of ionic radii 3d, 4d and 5d series elements, magnetic properties, Stability of various oxidation states and Latimer and Frost diagrams, Structure of some compounds of transition elements- TiO_2 , VOCl_2 , FeCl_3 , CuCl_2 and $\text{Ni}(\text{CO})_4$. Chemistry of f-Block elements Lanthanide contraction, oxidation states, magnetic properties, complex formation, colour and ionic radii. Actinides: General characteristics of actinides, Transuranic elements, comparison of properties of Lanthanides and actinides with transition elements.	12
II	Thermodynamics-I First law of thermodynamics: statement, concepts of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule– Thomson coefficient for ideal gas and real gas and inversion temperature. Calculation of w , q , dU & dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process. Second law of thermodynamics Carnot cycles and its efficiency, Concept of entropy, entropy as a function of V & T , entropy as a function of P & T Chemical Equilibrium Concept of Equilibrium constant, Temperature dependence of equilibrium constant, Clausius–Clapeyron equation and its applications.	11

III	Alcohols Monohyric alcohols: nomenclature, methods of formation by reduction of aldehydes, ketones, carboxylic acids, and esters. Hydrogen bonding, Acidic nature, Reactions of alcohols. Phenols Nomenclature, structure, and bonding. Preparation: Cumene hydroperoxide method, from diazonium salts, physical properties, and acidic character. Chemical Reactions: — electrophilic aromatic substitution, Mechanisms of Fries rearrangement, Claisen rearrangement, Reimer-Tiemann reaction, Kolbe's reaction	11
IV	Aldehydes and Ketones Nomenclature and structure of the carbonyl group. Preparation: oxidation of alcohols, from acid chlorides and from nitriles, Comparison of reactivities of aldehydes and ketones. Mechanism of nucleophilic additions to carbonyl group: benzoin, aldol, Perkin and Knoevenagel condensations. Condensation with ammonia and its derivatives. Wittig reaction. Mannich reaction, Baeyer–Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen and Wolff-Kishner reductions.	11
V*	Practicals: 1. To prepare salicylic acid from Aspirin. 2. To prepare m-nitroaniline from m-dinitrobenzene. 3. Semimicro qualitative analysis of mixture containing not more than four radicals (excluding interfering, Combinations and insoluble): Pb^{2+} , Cu^{2+} , Fe^{3+} , Ni^{2+} , Ca^{2+} , NH_4^+ , CO_3^{2-} , NO_3^- , CH_3COO^- , Cl^- , Br^- , I^- , PO_4^{3-} , SO_4^{2-}	30

Internal Assessment:20+10* Theory • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 Practicum • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	End Term Examination: 50+20*
Part C-Learning Resources	
Recommended Books/e-resources/LMS: 1. Huheey, J.E.; Keiter, E.A.; Keiter; R. L.; Medhi, O.K. 009), Inorganic Chemistry- Principles of Structure and Reactivity, Pearson ucation. 2. Atkins, P.W.; Paula, J.de. (2014), Atkin's Physical Chemistry Ed., 10th Edition, Oxford University Press. 3. Kapoor, K.L.(2015), A Textbook of Physical Chemistry, Vol 1, 6th Edition, McGraw Hill Education. 4. Clayden, J.; Greeves, N.; Warren, S. (2012), Organic Chemistry, Oxford. 5. Morrison, R. N.; Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). 6. Nasipuri, D.(2018), Stereochemistry of Organic Compounds: Principles and Applications, 3rd Edition, New Age International. 7. Gunstone, F. D. (1975), Guidebook to Stereochemistry, Prentice Hall Press. 8. Lee, J. D. ; Concise Inorganic Chemistry 5th Edition , ; Wiley-INDIA	

*Applicable for courses having practical component.



MCC-7

Session: 2024-25			
Part A - Introduction			
Subject	Chemistry		
Semester	IV		
Name of the Course	Organic Chemistry-I		
Course Code	24UN-CHE-402		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	MCC		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	Chemistry as a subject at 4.0 Level (Class-XII)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: - Understand about Amino Acids, Peptides and Proteins Amino acids, Peptides and their classification and their properties - Know about the basic structure of proteins with reference to DNA and RNA and also the phenomenon of transcription and translation - Learn about basic idea of carbohydrates and lipids including their classification and importance - Learn about the Organic Synthesis via Enolates and some simple heterocyclic compounds - To get knowledge about identification and confirmation of acidic basic radicals in a given inorganic salts/mixture		
Credits	Theory	Practical	Total
	03	01	04
Contact Hours/week	03	02	05
Internal Assessment Marks	20	10	30

End Term Exam Marks	50	20	70
Examination Time	03 Hours	03 Hours	---
Maximum Marks: 100 (Theory :70 & Practical: 30)			

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.

Unit	Topics	Contact Hours
I	Amino Acids, Peptides and Proteins Amino acids, Peptides, and their classification. α -Amino Acids - Synthesis, ionic properties, and reactions. Zwitterions, pKa values, isoelectric point, and electrophoresis; Study of peptides: determination of their primary structure-end group analysis. Synthesis of peptides using N-protecting, C-protecting, and C- activating groups.	12
II	Nucleic Acids: Structure of components of nucleic acids: Bases, Sugars, Nucleosides and Nucleotides. Nomenclature of nucleosides and nucleotides, structure of polynucleotides (DNA and RNA), concept of DNA duplex formation and its characterization. Biological roles of DNA and RNA. Concept of heredity: Genetic Code, Replication, Transcription and Translation.	11
III	Carbohydrates Occurrence, classification, and their biological importance. Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projection and conformational structures; Interconversion of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation; Disaccharides – Structure elucidation of maltose and sucrose. Lipids Occurrence, classification, and their biological importance. Introduction to oils and fats; common fatty acids present in oils and fats, Hydrogenation of fats and oils, Saponification value,	11

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	acid value, iodine number.	
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IV	Organic Synthesis via Enolates Acidity of α-hydrogens, alkylation of diethyl malonate and ethyl acetoacetate. Synthesis of ethyl acetoacetate: the Claisen condensation. Keto-enol tautomerism of ethyl acetoacetate. Heterocyclic Compounds Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reactions in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole.	11
Practical		
	1. To prepare salicylic acid from Aspirin. 2. Identification and confirmation of acidic radicals in a given inorganic mixture via Semimicro qualitative analysis of mixture containing not more than two radicals (excluding interfering, Combinations and insoluble): CO_3^{2-}, S^{2-}, SO_3^{2-}, $\text{S}_2\text{O}_3^{2-}$, NO_2^-, CH_3COO^-, Cl^-, Br^-, I^-, NO_3^-, BO_3^{3-}, SO_4^{2-}	30
Suggested Evaluation Methods		
Internal Assessment: ➤ Theory: 20 • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➤ Practicum: 10 • Class Participation: NA • Seminar/ Demonstration/ Viva -voce/ Lab records etc.: 10 • Mid-Term Exam: NA		End Term Examination: ➤ Theory: 50 Written examination ➤ Practicum: 20 Lab record, viva-voce, Demonstration of practical
Part C-Learning Resources		

Recommended Books/e-resources/LMS:

1. Ltd. (Pearson Education).
2. Finar, I. L. **Organic Chemistry** (Volume 1& 2), Dorling Kindersley (India) Pvt. Ltd. \ (Pearson Education)
3. Solomons, T. W. G.; Fryhle, C. B. ; Snyder, S. A. (2016), **Organic Chemistry**, 12th Edition, Wiley.
4. Bruice, P. Y. (2017), **Organic Chemistry**, 8th Edition, Pearson.
5. Clayden, J.; Greeves, N.; Warren, S. (2012), **Organic Chemistry**, Oxford.
6. Nasipuri, D.(2018), **Stereochemistry of Organic Compounds: Principles and Applications**, 3rd Edition, New Age International.
7. Gunstone, F. D. (1975), **Guidebook to Stereochemistry**, Prentice Hall Press

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MCC-8

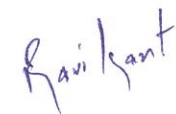
Session: 2024-25			
Part A - Introduction			
Subject	Chemistry		
Semester	IV		
Name of the Course	Physical Chemistry-II		
Course Code	24UN-CHE-403		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VA C)	MCC		
Level of the course (As per Annexure-I)	200-299		
Pre-requisite for the course (if any)	Chemistry as a subject at 4.0 Level (Class-XII)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Know the concept of phase rule and equilibria with reference to two component system 2. Learn about the Binary solutions and also some theoretical aspects related with this concept 3. Know about the general concept of electrochemistry and also various laws associated with this concept 4. Know about the Concentration cells with and without transference, liquid junction potential and also the basic idea about the surface chemistry 5. To get knowledge about identification and confirmation of basic radicals in a given inorganic salts/mixture		
Credits	Theory	Practical	Total
	03	01	04
Contact Hours/week	03	02	05
Internal Assessment Marks	20	10	30

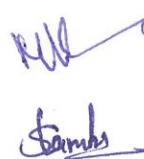
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End Term Exam Marks	50	20	70
Examination Time	03 Hours	03 Hours	---
Maximum Marks: 100 (Theory :70 & Practical: 30)			

Part B- Contents of the Course		
Instructions for Paper- Setter Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.		
Unit	Topics	Contact Hours
I	Statement and meaning of the terms – phase, component and degree of freedom, thermodynamic derivation of Gibbs phase rule, phase equilibria of one component system –Example – water system. Phase equilibria of two component systems solid-liquid equilibria, simple eutectic Example Pb-Ag system, desilverisation of lead.	12
II	Binary solutions: Gibbs-Duhem-Margules equation, its derivation, and applications to fractional distillation of binary miscible liquids (ideal and non-ideal), azeotropes, lever rule, partial miscibility of liquids, CST, miscible pairs, steam distillation. Electrochemical Cells: Rules of oxidation/reduction of ions based on half-cell potentials, Chemical cells, reversible and irreversible cells with examples	11
III	Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half- cells. Application of EMF measurements in determining (i) free energy, enthalpy, and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone.	11

IV	Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers. Qualitative	11
	discussion of potentiometric titrations (acid-base, redox). Surface chemistry: Physical adsorption, chemisorption, adsorption isotherms (Langmuir and Freundlich).	
Practical		
	Identification and confirmation of basic radicals in a given inorganic mixture via Semimicro qualitative analysis of mixture containing not more than two radicals (excluding interfering, Combinations and insoluble): Pb^{2+} , Cu^{2+} , Fe^{3+} , Ni^{2+} , Ca^{2+} , NH_4^+ , Al^{3+} , Co^{2+} , Zn^{2+} , Mg^{2+} .	30
Suggested Evaluation Methods		
Internal Assessment: ➤ Theory: 20 • Class Participation: 5 • Seminar/presentation/ assignment/ quiz/ class test etc.: 5 • Mid-Term Exam: 10 ➤ Practicum: 10 • Class Participation: NA • Seminar/ Demonstration/ Viva -voce/ Lab records etc.: 10 • Mid-Term Exam: NA		End Term Examination: ➤ Theory: 50 Written examination ➤ Practicum: 20 Lab record, viva-voce, Demonstration of practical
Part C-Learning Resources		




Recommended Books/e-resources/LMS:

1. Atkins, P.W.; Paula, J.de. (2014), **Atkin's Physical Chemistry Ed.**, 10th Edition, Oxford University Press.
2. Ball, D. W. (2017), **Physical Chemistry**, 2nd Edition, Cengage Learning, India.
3. Castellan, G. W. (2004), **Physical Chemistry**, 4th Edition, Narosa.
4. Kapoor, K.L. (2015), **A Textbook of Physical Chemistry**, Vol 1, 6th Edition, McGraw Hill Education.

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A signature that appears to be 'Sanku' with an arrow pointing right.
A signature that appears to be 'Jal' with an arrow pointing right.
A signature that appears to be 'Ravikant' written vertically on the right.
A signature that appears to be 'B' with an arrow pointing right.
A signature that appears to be 'MK' with an arrow pointing right.

DSE-1

Session: 2024-25			
Part A - Introduction			
Subject	Chemistry		
Semester	IV		
Name of the Course	Elective Chemistry -I		
Course Code	24UN-CHE-404		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VA C)	DSE		
Level of the course (As per Annexure-I)	200-299		
Pre-requisite for the course (if any)	Chemistry as a subject at 4.0 Level (Class-XII)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Know the basics of polymers, their classification and uses. 2. Get aware of the different methods to calculate the molecular weight of polymers. 3. Know the Properties of Polymers (Physical, thermal, Flow & Mechanical Properties). 4. Have a detail idea about some specific polymers like polyolefin, polystyrene and styrene copolymers, poly (vinyl chloride) 5. To do the hand on practice in the preparation of polymers and also analysis the role of initiator/binders in the synthesis.		
Credits	Theory	Practical	Total
	03	01	04
Contact Hours/week	03	02	05
Internal Assessment Marks	20	10	30
End Term Exam Marks	50	20	70
Examination Time	03 Hours	03 Hours	---

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Maximum Marks: 100 (Theory :70 & Practical: 30)

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non- programmable calculator is allowed.

Unit	Topics	Contact Hours
I	Introduction and history of polymeric materials: History of polymeric materials, Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers Functionality and its importance: Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization Bifunctional systems, Mechanism of copolymerization, polymerization techniques	12
II	Determination of molecular weight of polymers (M_n , M_w , etc.) by end group analysis, viscometry, light scattering, and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index Polymer Solution Criteria for polymer solubility and Solubility parameter.	11
III	Thermodynamics of polymer solutions, entropy, enthalpy, and free energy change of mixing of polymers solutions. Polymer Degradation Thermal, oxidative, hydrolytic and photodegradation, Properties of Polymers (Physical, thermal, Flow & Mechanical Properties).	11
IV	Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly (vinyl chloride) and related polymers and poly (vinyl acetate), acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite), silicone polymers	11
Practical		

	1. To determine the Numer average molecular weight of polymers by viscometry method. 2. To prepare Copolymers using atleast two monomers. 3. Study the role of initiator in the synthesis of polymers. 4. To synthesize the polymers using different binding reagent 5. To determine the weight average molecular weight of polymers by viscometry method.	30
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Suggested Evaluation Methods

Internal Assessment:

> Theory:20

- Class Participation: 5
- Seminar/presentation/assignment/quiz/class test etc.: 5
- Mid-Term Exam: 10

> Practicum:10

- Class Participation: NA
- Seminar/ Demonstration/ Viva - voce/ Lab records etc.: 10
- Mid-Term Exam: NA

End Term Examination:

> Theory: 50
Written examination

> Practicum: 20

Lab record, viva-voce, Demonstration of practical

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Hill, J.W.; McCreary, T.W.; Kolb, D.K. (2013), **Chemistry for changing times**, Pearson.
2. Carraher, C. E. Jr. (2013), **Seymour's Polymer Chemistry**, Marcel Dekker, Inc.
3. Odian, G. (2004), **Principles of Polymerization**, John Wiley.
4. Billmeyer, F.W. (1984), **Text Book of Polymer Science**, John Wiley.
5. Ghosh, P. (2001), **Polymer Science & Technology**, Tata Mcgraw-Hill.
6. Lenz, R.W. (1967), **Organic Chemistry of Synthetic High Polymers**, Interscience (Wiley)
7. Polymer chemistry by Gowarikar

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8. Principles of Polymerization by George G. Odian

9. Introduction to Polymer Chemistry by Charles E. Carraher

10. Polymer chemistry by Paul C. Hiemenz

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Carraher *Hiemenz*

DSE-1**Session: 2024-25****Part A - Introduction**

Subject	Chemistry		
Semester	IV		
Name of the Course	Elective Chemistry -II		
Course Code	24UN-CHE-405		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VA C)	DSE		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	Chemistry as a subject at 4.0 Level (Class-XII)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Learn the basic concept of Acid base theory. 2. Aware about organometallic chemistry and the uses of metal carbonyls. 3. Having an idea of bioinorganic chemistry and role of different ions in the biological system 4. Get aware about properties of silicones and phosphazenes. 5. To get knowledge about the functioning of different metal ions in biological system		
Credits	Theory	Practical	Total
	03	01	04
Contact Hours/week	03	02	05
Internal Assessment Marks	20	10	30
End Term Exam Marks	50	20	70
Examination Time	03 Hours	03 Hours	---

Max. Marks: 100 (Theory: 70 & Practical: 30)

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non- programmable calculator is allowed.

Unit	Topics	Contact Hours
I	Acids and Bases Arrhenius, Bronsted-lowry, Lux-flood, solvent system and Lewis concept of acids and bases, relative strength of acids and bases, levelling solvents, hard and soft acids and bases (HSAB), Applications of HSAB principle.	12
II	Organometallic chemistry Definition, classification and nomenclature of organometallic compounds, preparation, properties, and bonding of alkyls of Li, Al, Hg and Sn, concept of hapticity of organic ligand, Structure and bonding in metal- ethylenic complexes, Structure of Ferrocene, classification in metal carbonyls, preparation, properties and bonding in mononuclear carbonyls.	11
III	Bioinorganic chemistry Metal ions present in biological system, classification based on action (essential, non-essential, trace, toxic), Metalloporphyrins with special reference to haemoglobin and myoglobin. Biological role of Na^+ , K^+ , Ca^{+2} , Mg^{+2} , Fe^{+2} ions, Cooperative effect, Bohr effect.	11
IV	Silicones and Phosphazenes Nomenclature, classification, preparation and uses of silicones, elastomers, polysiloxane copolymers, poly phosphazenes and bonding in triphosphazene.	11
Practical		
	1. To analyse the various heavy metal ions present in the various natural and biological samples. 2. To identify and quantify the calcium present in the various biological samples 3. Determination of stability constant of a chelate i.e complex between metal ion and ligand.	30

	4. To identify the different types of contrasting agents and their interactions as used in diagnostic procedures.	
Suggested Evaluation Methods		
Internal Assessment: ➤ Theory:20 • Class Participation: 5 • Seminar/presentation/ assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➤ Practicum:10 • Class Participation: NA • Seminar/ Demonstration/ Viva -voce/ Lab records etc.: 10 • Mid-Term Exam: NA		End Term Examination: ➤ Theory: 50 Written examination ➤ Practicum: 20 Lab record, viva-voce, Demonstration of practical
Part C-Learning Resources		
Recommended Books/e-resources/LMS: 1. Svehla, G. (1996), Vogel's Qualitative Inorganic analysis, 7th Edition, Prentice Hall. 2. Huheey, J.E.; Keiter, E.A., Keiter; R. L.; Medhi, O.K.(2009), Inorganic Chemistry Principles of Structure and Reactivity, Pearson Education. 3. Shriver, D.D.; Atkins, P.; Langford, C.H. (1994), Inorganic Chemistry 2nd Ed., Oxford University Press. 4. Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A. (2010), Shriver and Atkins Inorganic Chemistry, 5th Edition, W. H. Freeman and Company. 5. Cotton, F.A.; Wilkinson, G.; Gaus, P.L. Basic Inorganic Chemistry, 3rd Edition, Wiley India. 6. Greenwood, N.N.; Earnshaw, A.(1997), Chemistry of the Elements, 2nd Edition, Elsevier(Ziegler Natta Catalyst and Equilibria in Grignard solution). 7. Powell, P. (1988), Principles of Organometallic Chemistry, Chapman and Hall.		

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DSE-1

Session: 2024-25

Part A – Introduction

Subject	Chemistry		
Semester	IV		
Name of the Course	Elective Chemistry-III		
Course Code	24UN-CHE-406		
Course Type: (CC/MCC/MD C/CC- M/DSEC/VOC/DSE/PC/AEC/ VAC)	DSE		
Level of the course (As per Annexure-I)	200-299		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Get the knowledge of drug development; 2. Learn about several types of drugs; 3. Understand about several types of cardiovascular drugs; 4. To know the basics of nutritional chemistry. 5*. To create and analyse drug molecules.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75
Max. Marks: 70+30* Internal Assessment Marks: 20 + 10* End Term Exam Marks: Theory: 50 + 20*		Time: Theory: 03 hrs Practicum: 03 hrs	
Part B- Contents of the Course			
Instructions for Paper- Setter			
Note: The examiner is requested to set nine questions in all, selecting two questions from each			

SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory.

Unit	Topics	Contact Hours
I	Brief history of drug development. Definition, uses and side effects of the following categories of drugs: Antipyretics, analgesics & anti-inflammatory agents (paracetamol, aspirin, ibuprofen and diclofenac); Anti-tussive and expectorant (dextromethorphan, bromhexene); Decongestant (pseudoephedrine, phenylpropanolamine); Anti-allergic (Citrizine, Levocitrizine, diphenhydramine).	12
II	Definition, uses and side effects of the following categories of drugs: Antibacterial drugs (ampicillin, amoxycillin, cephalixin, ciprofloxacin); Antimalarial (Chloroquine, chloroguanide), Anti-amoebic (Metronidazole, tinidazole); Anthelmintic and anti-parasitic (Mebendazole, Albendazole); Anticancer (Chlorambucil, cyclophosphamide), Antihypertensive (amlodipin, atenolol);	11
III	Definition, uses and side effects of the following categories of drugs: Cardiovascular drugs (sorbitrate, diltiazem). Electrolytes (Sodium, Potassium, Chlorides), Renal (Kidney) Function Tests (Creatinine, Blood urea nitrogen), Liver Function Test (Total Protein (Serum), Bilirubin; direct; indirect; total) Cardiac Markers , Minerals (Calcium, magnesium, Phosphate, Potassium), Blood Disorders (Iron, Vitamin B12, Vitamin D, Folic acid) Miscellaneous (Glucose, Glycosylated hemoglobin, Uric acid).	11
IV	Nutritional Chemistry Fat Soluble and water-soluble vitamins (Sources, recommended levels and deficiency diseases; Vitamin A, Vitamin B1, Vitamin B2, Vitamin B3, Vitamin B5, Vitamin B6, Vitamin B7, Vitamin B9, Vitamin B12, Vitamin C, Vitamin D, Vitamin E and Vitamin K). Daily Intake and Roles in Biological processes of following essential dietary minerals Major Minerals- Calcium, Phosphorus, potassium, sodium and magnesium; trace elements- sulfur, Iron, Chlorine, cobalt, Copper, Molybdenum, Iodine and Selenium.	11

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V*	1. Preparation of Aspirin and its analysis. 2. Preparation of Paracetamol and its analysis. 3. Preparation of Ibuprofen and its analysis. 4. Preparation of magnesium bisilicate (Antacid).	30
Suggested Evaluation Methods Short Answer and MCQ Type QUESTIONS		
Internal Assessment: 20+10*=30 ➤ Theory: 20 • Class Participation: 05 • Seminar/presentation/assignment/quiz/class test etc.:05 • Mid-Term Exam: 10 ➤ Practicum:10 • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA		End Term Examination: 50+20*
Part C-Learning Resources		
Recommended Books/e-resources/LMS: ✓ Medicinal chemistry; 7th edition, New age international publisher by Ashutosh Kar ✓ Medicinal chemistry; 3rd edition, Handbook of Nutrition and Food, CRC Press by D. Sriram, P. Yogeshwari, Berdanier, Carolyn D., Dwyer, Johanna T., Heber, and David. ✓ The vitamins: fundamental aspects of nutrition and health; Academic press by G. F. Combs Jr. and G.F. combs Sr ✓ Organic Chemistry, Volume-II, Stereochemistry and the chemistry of natural products by IL Finar, 5th edition, Pearson Education India.		

*Applicable for courses having practical component.

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CC-M4(V)

Session: 2024-25

Part A – Introduction

Subject	Chemistry		
Semester	IV		
Name of the Course	Chemistry of cosmetics & perfumes		
Course Code	24UN-CHE-VOC-2		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	VOC		
Level of the course (As per Annexure-I)	200-999 7		
Pre-requisite for the course (if any)	--		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Get the knowledge of cosmetics; 2. Logically think regarding preparation strategies and uses of cosmetic products; 3. Understand about preparation strategies and uses of cosmetic creams; 4. Get to know about the essential oils preset in nature & their importance towards industrial uses. 5*. learn about practical hands involved in preparation of cosmetic products.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75
Max. Marks: 70 + 30* Internal Assessment Marks: 20 + 10* End Term Exam Marks: 50 + 20*		Time: Theory: Three Hours Practicum: Three Hours	
Part B- Contents of the Course			

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory.

Unit	Topics	Contact Hours
I	Cosmetics- Definition, History, Classification, Ingredients, Nomenclature, A general study including preparation and uses of the following: Hair dye, Hair spray, Shampoo, conditioners, Suntan lotions.	12 Hrs
II	Preparation and uses of Face powder, Lipsticks, Talcum powder, Nail enamel.	11 Hrs
III	Preparation and uses of creams (cold, vanishing, and shaving creams), Antiperspirants and Artificial flavours.	11 Hrs
IV	Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, Sandalwood oil, Eucalyptus, Rose oil, 2-Phenyl ethyl alcohol, Jasmone, Civetone, Muscone.	11 Hrs
V*	1. Preparation of Talcum powder. 2. Preparation of Shampoo. 3. Preparation of Enamels. 4. Preparation of Hair remover. 5. Preparation of Face cream. 6. Preparation of Nail polish. 7. Preparation of Nail polish remover.	30 Hrs

Suggested Evaluation Methods

Short Answer and MCQ Type QUESTIONS

Internal Assessment: 20+10*=30

➤ **Theory: 20**

- Class Participation: 05
- Seminar/presentation/assignment/quiz/class test etc.:05
- Mid-Term Exam: 10

➤ **Practicum:10**

- Class Participation: 05
- Seminar/Demonstration/Viva-voce/Lab records etc.: 05
- Mid-Term Exam: N. A.

**End
Term
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tion:
50+20***

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- ✓ E. Stocchi: *Industrial Chemistry*, Vol -I, Ellis Horwood Ltd. UK.
- ✓ P.C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
- ✓ B.K. Sharma: *Industrial Chemistry*, Goel Publishing House, Meerut.
- ✓ Textbook of Cosmetics; M Vimaladevi; CBS Publishers & Distributors; 2015, ISBN 81-239-1103-3
- ✓ TextBook of Cosmetics; Dr Akanksha Garud, Dr PK Sharma, Dr Navneet Garud; Pragati Prakashan; 2012, ISBN 978-93-5006-691-1
- ✓ Pharmaceutics and Cosmetics; Praveen K. Gupta, Sanjeev K. Gupta; Pragati Prakashan; 2011, ISBN 978-81-8398-995-4
- ✓ Chemistry of Cosmetics; R. Kumari; Prestige Publisher, 2018, ISBN 978-81-936512-3-0
- ✓ Formulation Guide For Cosmetics; The Nisshin Oillio Group, Ltd.

*Applicable for courses having practical component

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Session 2024-25			
Part A- Introduction			
Subject	Chemistry		
Semester	V		
Name of Course	Chemistry-V		
Course Code	24UN-CHE-501		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC/MCC		
Level of Course (As per Annexure-I)	300 - 399		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Enable to understand the basis of coordination chemistry of complexes. 2. To learn about role of thermodynamics and equilibrium in predicting various physical properties of systems. 3. Get knowledge about the quantum mechanical properties and analysis of diatomic molecules by spectroscopy. 4. To understand the synthesis and mechanism of some organic reactions and heterocyclic compounds. 5*. Hand on practice in preparation of metal complexes, identification of organic and measurement of surface tension of solutions.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Examination Time: 03+03* Hours		

Part B- Contents of the Course

Instructions for Paper-Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1)) based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.

Unit	Topic	Contact Hours
I	Coordination Compounds: Werner's theory of coordination compounds, EAN, chelates, nomenclature of coordination compounds, isomerism in coordination compounds. Metal Ligand Bonding in Transition Metal Complexes: Valence bond theory, applications and their Limitation, Elementary idea of CFT (Only structural aspects), Crystal field splitting in octahedral, tetrahedral and square planer complexes. Magnetic properties of transition metal complexes: Types of magnetic materials, magnetic susceptibility, spin only formula, basic idea of L-S coupling.	11
II	Thermodynamics-II: Third Law of Thermodynamics, Nernst Heat Theorem, Statement of concept of residual entropy, Gibbs function and Helmholtz Function as thermodynamic quantities. Criteria for thermodynamic equilibrium and spontaneity. Variation of G with P, V and T, Partial molar properties, concept of chemical potential (numerical included) Phase Equilibria: Statement and the meaning of terms-phase component and degree of freedom, Thermodynamic derivation of Gibbs phase rule, Phase equilibria of one component system-water system, phase equilibria of two component systems solid-liquid equilibria, simple Eutectic Pb-Ag system.	11
III	Quantum Mechanics-I: Black body radiation, plank's radiation law, Explanation of spectral distribution of black body radiation on the basis of classical mechanics and quantum mechanics, photoelectric effect, Need of quantum mechanics, postulates of quantum mechanics, quantum mechanical operator, Angular momentum operator Commutation relations, Hamiltonian operator, Role of operators to derive Schrodinger wave equation, Application of Schrodinger wave equation in determination of wave function, pictorial representation and determination of energy of particle in one dimensional box and extending it to three dimensional box.	11

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IV	Organic Synthesis via Enolates Acidity of α -hydrogens, alkylation of diethyl malonate and ethyl acetoacetate. Synthesis of ethyl acetoacetate: the Claisen condensation. Keto-enol tautomerism of ethyl acetoacetate. Heterocyclic Compounds Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reactions in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole.	12
V*	1. Systematic identification (detection of extra elements, Functional Groups, determination of Melting Point and preparation of at least one solid derivative) of the following simple mono-functional organic compounds: Naphthalene, p-dichlorobenzene, m-dinitrobenzene, α & β naphthol, Oxalic acid, succinic acid, benzoic acid, phthalic acid, Benzamide, urea, thiourea, glucose, fructose and sucrose. 2. Determine the solubility product of Ca(OH)_2 at room temperature by titrating it against 0.5 N HCl solution volumetrically. 3. Determine electrode potential of Zinc and Copper electrode in 0.1 M and 0.01M solution and calculate E° value for these electrodes.	30

Suggested Evaluation Methods

Internal Assessment: 20+10*

□ Theory

- Class Participation: 5
- Seminar/Presentation/Assignment/Quiz/Class Test etc: 5
- Mid Term Exam: 10

□ Practicum

- Class Participation: NA
- Seminar/Demonstration/Viva-voce/Lab records etc: 10
- Mid-Term Exam: NA

End Term Examination:
50+20*

Part C- Learning Resources

Recommended Books/e-resources/LMS:

1. Organic Chemistry Volume III by Mukherji, Singh, Kapoor and Dass, Published by New Age International Pvt. Ltd., New Delhi.
2. Huheey, J.E.; Keiter, E.A., Keiter; R. L.; Medhi, O.K. (2009), Inorganic Chemistry Principles of Structure and Reactivity, Pearson Education.
Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A. (2010), Inorganic Chemistry, 5th Edition, W. H. Freeman and Company
3. Lee, J.D.; (2010), Concise Inorganic Chemistry, Wiley India.
4. Peter, A.; Paula, J. de. (2011), Physical Chemistry, 9th Edition, Oxford University Press.

5. Castellan, G. W. (2004), Physical Chemistry, 4th Edition, Narosa.
6. Kapoor, K.L. (2015), A Textbook of Physical Chemistry, Vol 2, 6th Edition, McGraw Hill Education.
7. Kapoor, K.L., A Textbook of Physical Chemistry, Vol 3, 5th Edition, McGraw Hill Education
8. House, J.E. (2004), Fundamentals of Quantum Chemistry, 2nd Edition, Elsevier.
9. McQuarrie, D.A. (2016), Quantum Chemistry, Viva Books.
10. Chandra, A. K. (2001), Introductory Quantum Chemistry, Tata McGraw-Hill.
11. House, J.E. (2004), Fundamentals of Quantum Chemistry, 2nd Edition, Elsevier
12. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson 75 Education).
13. Ahluwalia, V.K.; Bhagat, P.; Aggarwal, R.; Chandra, R. (2005), Intermediate for Organic Synthesis, I.K. International
14. B.D. Khosla, V.C.Garg, A. Gulati, Senior Practical Physical Chemistry R. Chand & Company, New Delhi

*Applicable for courses having Practical component

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MCC-10

Session 2024-25			
Part A- Introduction			
Subject	Chemistry		
Semester	V		
Name of Course	Inorganic Chemistry-II		
Course Code	24UN-CHE-502		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	MCC		
Level of Course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Enable to understand the thermodynamic and kinetic aspects of metal complexes. 2. To learn about electronic spectra of transition metal complexes. 3. Get knowledge about the some advance studies in investigating electronic spectra of transition metal complexes 4. To know about the concept of organometallic complexes, their classification with reference to σ bonded organometallics 5*. Hand on practice in preparation of solutions, compounds, estimation and determination of physical properties of some compounds.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Examination Time: 03+03* Hours		
Part B- Contents of the Course			
<u>Instructions for Paper-Setter</u>			
Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1)) based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all			

selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator allowed.

Unit	Topics	Contact Hours
I	Thermodynamic and Kinetic aspects of Metal Complexes: A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, Erving William Series, Substitution reactions of Square planar complexes of Pt(II), Trans Effect and theories.	11
II	Electronic spectra of transition metal complexes-I: Calculation of microstates, Rules for d-d transition, term symbols, spectroscopic ground states, spectrochemical series, Orgel energy level diagrams for d^1 to d^9 states	11
III	Electronic spectra of transition metal complexes-II: General theory of Tanabe-Sugano diagrams for transition metal complexes, Graphical presentation and explanation of T-S diagram for d^1 to d^9 states, Discussion of electronic spectrum $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$	11
IV	Organometallic Chemistry: Definition, classification and nomenclature of organometallic compounds, preparation, properties, and bonding of alkyls of Li and Hg, concept of hapticity of organic ligand, Structure and bonding in metal-ethylenic complexes $[\text{PtCl}_2(\text{C}_2\text{H}_4)]$, Structure of Ferrocene, classification in metal carbonyls, properties and bonding in mononuclear carbonyls.	12
V*	1. Preparation: preparation of Mohr salt, prussian blue, Chrome alum, potash alum. 2. Gravimetric analysis: Estimation of copper as CuSCN and Al^{3+} as aluminiumoxinate.	

Suggested Evaluation Methods

Internal Assessment: 20+10*

☐ Theory

- Class Participation: 5
- Seminar/Presentation/Assignment/Quiz/Class Test etc: 5
- Mid Term Exam: 10

☐ Practicum

- Class Participation: NA
- Seminar/Demonstration/Viva-voce/Lab records etc: 10
- Mid-Term Exam: NA

End Term Examination: 50+20*

Part C- Learning Resources

Recommended Books/e-resources/LMS:

1. Huheey, J.E.; Keiter, E.A.; Keiter, R. L.; Medhi, O.K. (2009), Inorganic Chemistry Principles of Structure and Reactivity, Pearson Education.
2. Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F. A. (2010), Inorganic

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Chemistry, 5th Edition, W. H. Freeman and Company

3. Lee, J.D.; (2010), Concise Inorganic Chemistry, Wiley India.
4. Gupta, B. D., Elias, A. J., (2013) Basic Organometallic Chemistry: Concepts, Syntheses and Applications, 2nd Edition, Universities Press.
5. Cotton, F.A.; Wilkinson, G.; Gaus, P.L. Basic Inorganic Chemistry, 3rd Edition, Wiley

*Applicable for courses having Practical component

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DSE-2

Session: 2024-25			
Part A - Introduction			
Subject	Chemistry		
Semester	V		
Name of the Course	Elective Chemistry-IV		
Course Code	24UN-CHE-503		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. To understand the basis concept about carboxylic acid & their derivatives. 2. To learn about synthesis and chemical reactions of amines. 3. Get knowledge about the chemical reactions of ether, epoxides and diazonium salts. 4. To know about synthetic polymer & dyes and their uses. 5*.. To learn about different functional groups, identification of compounds and their derivatives.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Examination Time:03 + 03* Hours		
Part B- Contents of the Course			
<u>Instructions for Paper- Setter</u>			
Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.			
Unit	Topics		Contact Hours

I	Carboxylic Acids Nomenclature of Carboxylic acids, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids. Reactions of carboxylic acids. Hell-Volhard-Zelinsky reaction. Reduction of carboxylic acids.	12
	Mechanism of decarboxylation. Carboxylic Acid Derivatives Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Mechanisms of esterification and hydrolysis (acidic and basic).	
II	Amines Structure and nomenclature of amines, physical properties. Separation of a mixture of primary, secondary and tertiary amines. Structural features affecting basicity of amines. Preparation of alkyl and aryl amines (reduction of nitro compounds, nitriles, reductive amination of aldehydic and ketonic compounds. Gabrielphthalimide reaction, Hofmann bromamide reaction. Electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid.	11
III	Ether & Epoxides Preparation and reactions of ethers and epoxides with acids. Reactions of epoxides with alcohols, ammonia derivatives. Synthesis of epoxides. Acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides Diazonium Salts Mechanism of diazotisation, structure of benzene diazonium chloride, Replacement of diazo group by H, OH, F, Cl, Br, I, NO ₂ and CN groups, reduction of diazonium salts to hydrazines, coupling reaction and its synthetic application.	11
IV	Synthetic Polymers Addition or chain-growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers. Condensation or step growth polymerization. Polyesters, polyamides, phenol formaldehyde resins. Natural and synthetic rubbers Synthetic Dyes Classification, Colour and constitution; Mordant and Vat Dyes; Chemistry of dyeing; Synthesis and applications of: Azo dyes-Methyl orange; Triphenyl methane dyes-Malachite green, Phthalein Dyes – Phenolphthalein; Natural dyes –structure elucidation and synthesis of Alizarin; Edible Dyes with examples.	11
V*	1. Detection of extra elements. 2. Functional group test for nitro, amine and amide groups. 3. Qualitative analysis of unknown organic compounds containing simple functional groups (alcohols, carboxylic acids, phenols and carbonyl compounds) 4. Preparation of derivatives of given compounds. 5. Conformation of given compounds with the help of IR & NMR spectra.	30

Suggested Evaluation Methods	
Internal Assessment: 20+10* > Theory • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 > Practicum • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	End Term Examination: 50+20*
Part C-Learning Resources	
Recommended Books/e-resources/LMS: 1. Organic Chemistry Volume II & III by Mukherji, Singh, Kapoor and Dass, Published by New Age International Pvt. Ltd., New Delhi. 2. Morrison, R. N.; Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). 3. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson 75 Education). 4. Ahluwalia, V.K.; Bhagat, P.; Aggarwal, R.; Chandra, R. (2005), Intermediate for Organic Synthesis, I.K. International. 5. Solomons, T. W. G.; Fryhle, C. B.; Snyder, S. A. (2016), Organic Chemistry, 12th Ed., Wiley. 6. Flory, Paul J. Principles of polymer chemistry. (1953) Ithaca: Cornell University Press.	

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DSE-2**Session: 2024-25****Part A - Introduction**

Subject	Chemistry		
Semester	V		
Name of the Course	Elective Chemistry-V		
Course Code	24UN-CHE-504		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. To understand the function of enzymes and their classification. 2. To learn about energy biosystems. 3. Get knowledge about pharmaceutical compounds and their therapeutic uses. 4. To know about synthesis and chemical reactions of sulphur containing compound and polynuclear hydrocarbons. 5*. Hand on practice to synthesize various compounds and determination of their melting points.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Examination Time:03 + 03* Hours		

Part B- Contents of the Course**Instructions for Paper- Setter**

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.

Unit	Topics	Contact Hours
I	Enzymes Introduction, classification and characteristics of enzymes. Salient features of active site of enzymes. Mechanism of enzyme action (taking trypsin as example), factors affecting enzyme action, coenzymes and cofactors and their role in biological reactions,	12

	specificity of enzyme action (including stereospecificity), enzyme inhibitors and their importance, phenomenon of inhibition (competitive, uncompetitive and non-competitive inhibition including allosteric inhibition).	
II	Concept of Energy Biosystems Cells obtain energy by the oxidation of foodstuff (organic molecules). Introduction to metabolism (catabolism, anabolism). ATP: The universal currency of cellular energy, ATP hydrolysis and free energy change. Agents for transfer of electrons in biological redox systems: NAD ⁺ , FAD. Conversion of food to energy: Outline of catabolic pathways of carbohydrate- glycolysis, fermentation, Krebs cycle. Overview of catabolic pathways of fat and protein. Caloric value of food, standard caloric content of food types.	11
III	Pharmaceutical Compounds Classification, structure and therapeutic uses of antipyretics: Paracetamol (with synthesis), Analgesics: Ibuprofen (with synthesis), Antimalarials: Chloroquine (with synthesis). An elementary treatment of Antibiotics and detailed study of chloramphenicol, Medicinal values of curcumin (haldi), azadirachtin (neem), vitamin C and antacid (ranitidine).	11
IV	Sulphur Containing Compounds Preparation and reactions of thiols, thioethers and sulphonic acids. Polynuclear Hydrocarbons Aromaticity of polynuclear hydrocarbons, structure elucidation of naphthalene; Preparation and properties of naphthalene, phenanthrene and anthracene.	11
V*	1. Detection of extra elements. 2. Functional group test for nitro, amine and amide groups. 3. Qualitative analysis of unknown organic compounds containing simple functional groups (alcohols, carboxylic acids, phenols and carbonyl compounds) 4. Preparation of derivatives of given compounds.	30
Suggested Evaluation Methods		
Internal Assessment:20+10* ➤ Theory ● Class Participation: 5 ● Seminar/presentation/assignment/quiz/class test etc.: 5 ● Mid-Term Exam: 10 ➤ Practicum ● Class Participation: NA ● Seminar/Demonstration/Viva-voce/Lab records etc.: 10 ● Mid-Term Exam: NA		End Term Examination: 50+20*
Part C-Learning Resources		

Recommended Books/e-resources/LMS:

1. Organic Chemistry Volume I & II by Mukherji, Singh, Kapoor and Dass, Published by New Age International Pvt. Ltd., New Delhi.
2. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2006) Biochemistry. VIth Edition. W.H. Freeman and Co.
3. Nelson, D.L., Cox, M.M. and Lehninger, A.L. (2009) Principles of Biochemistry. IV Edition. W.H. Freeman and Co.
4. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009) Harper's Illustrated Biochemistry. XXVIII edition. Lange Medical Books/ McGraw-Hill

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DSE-2

Session: 2024-25			
Part A - Introduction			
Subject	Chemistry		
Semester	V		
Name of the Course	Elective Chemistry-VI		
Course Code	24UN-CHE-505		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. To understand the basis concept about carboxylic acid & their derivatives. 2. To learn about synthesis and chemical reactions of amines. 3. Get knowledge about pharmaceutical compounds and their therapeutic uses. 4. To know about synthesis and chemical reactions of sulphur containing compound and polynuclear hydrocarbons. 5*. To learn about different functional groups, identification of compounds and their derivatives.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:70+30*		Time:03 + 03*	
Internal Assessment Marks:20+10*			
End Term Exam Marks:50+20*			
Part B- Contents of the Course			
<u>Instructions for Paper- Setter</u>			
Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.			
Unit	Topics		Contact Hours

I	Carboxylic Acids Nomenclature of Carboxylic acids, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. General methods of preparation of carboxylic acids. Reactions of carboxylic acids. Hell-Volhard-Zelinsky reaction. Reduction of carboxylic acids. Mechanism of decarboxylation. Carboxylic Acid Derivatives Nomenclature and structure of Carboxylic acid derivatives, Physical properties, relative reactivities of acyl derivatives, interconversion of acid derivatives by nucleophilic acyl substitution. Mechanisms of esterification and hydrolysis (acidic and basic).	12
II	Amines Structure and nomenclature of amines, physical properties. Separation of a mixture of primary, secondary and tertiary amines. Structural features affecting basicity of amines. Preparation of alkyl and aryl amines (reduction of nitro compounds, nitriles, reductive amination of aldehydic and ketonic compounds. Gabrielphthalimide reaction, Hofmann bromamide reaction). Electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid.	11
III	Pharmaceutical Compounds Classification, structure and therapeutic uses of the followings: antipyretics: Paracetamol (with synthesis), Analgesics: Ibuprofen (with synthesis), Antimalarials: Chloroquine (with synthesis). Antibiotics: An elementary idea, Classification, Synthesis and uses of Penicillin-G, chloramphenicol, Medicinal values of curcumin (haldi), azadirachtin (neem), vitamin C and antacid (ranitidine).	11
IV	Sulphur Containing Compounds Preparation and reactions of thiols, thioethers and sulphonic acids. Polynuclear Benzenoid Aromatic Hydrocarbons Aromaticity of polynuclear hydrocarbons, structure elucidation of naphthalene; Preparation and properties of naphthalene, phenanthrene and anthracene.	11
V*	1. Detection of extra elements. 2. Functional group test for nitro, amine and amide groups. 3. Qualitative analysis of unknown organic compounds containing simple functional groups (alcohols, carboxylic acids, phenols and carbonyl compounds) 4. Preparation of derivatives of given compounds.	30
Suggested Evaluation Methods		
Internal Assessment:20+10* > Theory • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 > Practicum		End Term Examination:

• Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	50+20*
Part C-Learning Resources	
Recommended Books/e-resources/LMS: 1. Organic Chemistry Volume II by Mukherji, Singh, Kapoor and Dass, Published by New Age International Pvt. Ltd., New Delhi. 2. Morrison, R. N.; Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). 3. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson 75 Education). 4. Ahluwalia, V.K.; Bhagat, P.; Aggarwal, R.; Chandra, R. (2005), Intermediate for Organic Synthesis, I.K. International. 5. Solomons, T. W. G.; Fryhle, C. B.; Snyder, S. A. (2016), Organic Chemistry, 12th Ed., Wiley. 6. Flory, Paul J. Principles of polymer chemistry.(1953) Ithaca: Cornell University Press. 7. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2006) Biochemistry. VIth Edition. W.H. Freeman and Co. 8. Nelson, D.L., Cox, M.M. and Lehninger, A.L. (2009) Principles of Biochemistry. IV Edition. W.H. Freeman and Co. 9. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009) Harper's Illustrated Biochemistry. XXVIII edition. Lange Medical Books/ McGraw-Hill	

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DSE-3

Session 2024-25

Part A- Introduction

Subject	Chemistry		
Semester	V		
Name of Course	Elective Chemistry-VII		
Course Code	24UN-CHE-506		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE		
Level of Course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Enable to understand the basis of quantum mechanics. 2. To learn about concept of transition between vibrational energy levels of diatomic molecules and understand the Raman effect and Raman Spectroscopy. 3. Get knowledge of transition between various types of energy levels and NMR and ESR spectroscopic investigations of molecules. 4. To understand the principles and electronic spectra of simple molecules. 5*. Hand on practice in the investigations of distribution of solute in different solvents, degree of hydrolysis of organic salts.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Examination Time: 03+03* Hours		

Part B- Contents of the Course

Instructions for Paper-Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.

Unit	Topics	Contact Hours
I	Quantum Mechanics-II Operators, Hermitian Operator and its properties, quantum mechanical derivation of Heisenberg's uncertainty Principal, derivation of time –dependent Schrodinger wave equation and its Application to calculate the wave function and energy of particle moving in three dimensional box, concept of Degree of Degeneracy.	11
II	Vibrational Spectroscopy Vibrational energy levels of simple Harmonic Oscillator, selection rules, Vibrational spectra of simple Harmonic Oscillator, Types of molecule showing vibrational spectra, Energy level of anharmonic oscillator, selection rules for the vibrational transitions in anharmonic oscillator, vibration rotational spectra of diatomic molecules. P, Q and R branches of vibration and rotational spectra, Intensities of lines in P and R branches, Results of the vibrational rotational spectrum. Elementary idea of vibrational transition of polyatomic molecules, Concept of isotopic effect by vibrational spectra. Raman Spectroscopy Introduction, Concept of Rayleigh and Raman lines, Raman Shift, Stokes' lines and Anti-stokes' lines, Concept of polarizability of molecule and Raman spectra, Types of molecules showing Raman Spectra, Explanation of Raman Effect in terms of polarizability, Quantum theory of pure rotational Raman spectra and spectral intensities of diatomic molecule and application. Rotational vibrational Raman Spectra of diatomic molecules. Advantage of Raman spectra over other spectroscopy. Experimental arrangement for Raman Spectra.	11
III	Nuclear Magnetic Resonance (NMR) Spectroscopy Principles of nuclear magnetic resonance, spin quantum number and angular momentum for the nucleus of (H, C, N, O and P), Concept of splitting of energy levels in a magnetic field, Concept of ESR spectra differ from NMR spectra for taking example of hydrogen, NMR technique/spectrometer, Interpretation of NMR spectra (Ethyl alcohol, Ethyl acetate, Acetone, Benzaldehyde), Chemical shift, shielding and deshielding of protons, nuclear spin-spin interaction, application of NMR spectra. Electronic Spin Resonance Spectroscopy (ESR) Concept of ESR spectra for unpaired electron, g factor, hyperfine	11

	structure in ESR spectra, selection rules, hyperfine splitting constant, predicting lines in ESR spectra for hydrogen atom, methyl radical with energy level diagram. Difference between NMR and ESR concept.	
IV	Electronic Spectra Features of Electronic spectroscopy, theory of electronic transition and band spectra, dissociation energy of molecule predicting from Electronic spectroscopy, Potential energy curves and Frank-Condon principle, electronic spectra of diatomic molecules, concept of parity, multiplicity of states, term symbol of diatomic molecules, selection rule, Molecular orbital energy level diagram of H ₂ , N ₂ , CO and O ₂ . Molecular orbitals involved in electronic transitions, concept of HOMO and LUMO and chromophores.	12
V*	1. To determine the distribution coefficient of following: I ₂ between CCl ₄ /Chloroform and water, Benzoic acid between benzene and water, succinic acid between benzene and water, succinic acid between ether and water. 2. To determine the degree of Hydrolysis and hydrolysis constant of (i) CH ₃ COONa and (ii) NH ₄ Cl. 3. To study the inversion of cane sugar in presence of HCl and H ₂ SO ₄ , and hence determine the relative strength of the acids.	30
Suggested Evaluation Methods		
Internal Assesment:20+10* ☐ Theory • Class Participation: 5 • Seminar/Presentation/Assignment/Quiz/Class Test etc: 5 • Mid Term Exam: 10 ☐ Practicum • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc: 10 • Mid-Term Exam: NA		End Term Examination: 50+20*
Part C- Learning Resources		
Recommended Books/e-resources/LMS: 1. Organic Chemistry Volume III by Mukherji, Singh, Kapoor and Dass, Published by New Age International Pvt. Ltd., New Delhi. 2. Banwell, C.N.; McCash, E.M. (2006), Fundamentals of Molecular Spectroscopy, Tata McGraw- Hill. 3. Kapoor, K.L. (2015), A Textbook of Physical Chemistry, McGraw Hill Education, Vol 4, 5th Edition, McGraw Hill Education. 4. Kakkar, R. (2015), Atomic & Molecular Spectroscopy, Cambridge University Press 5. Engel, T.; Reid, P. (2013), Quantum Chemistry and Spectroscopy, Pearson.		

*Applicable for courses having Practical component

DSE-3

Session 2024-25

Part A- Introduction

Subject	Chemistry		
Semester	V		
Name of Course	Elective Chemistry-VIII		
Course Code	24UN-CHE-507		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE		
Level of Course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Understand the basics of quantum mechanical operators and investigate particle confined in three-dimensional box. 2. Able to solving Schrodinger Wave equation for Hydrogen like systems.. 3. Get the knowledge about Quantum mechanical formulation of VBT and MOT for diatomic molecule. 4. To understand the concept of adsorption and different adsorption isotherms. 5*. Hand on practice in the investigations of distribution of solute in different solvents, degree of hydrolysis of organic salts.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max marks:70+30*	Examination Time: 03+03*		
Internal Assessment Marks:20+10*			
End Term Exam Marks:50+20*			

Part B- Contents of the Course

Instructions for Paper-Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short

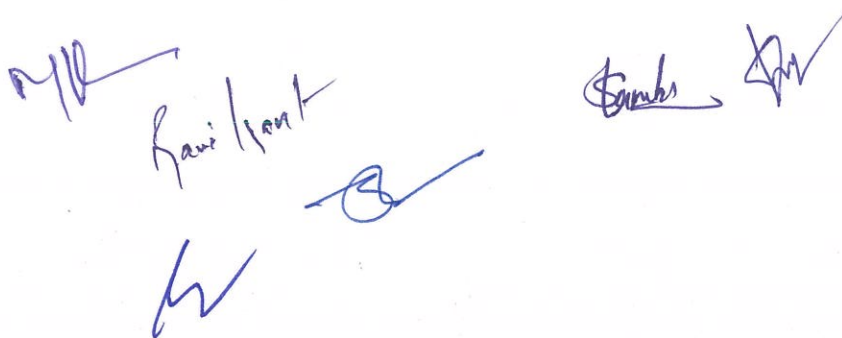
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answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.

Unit	Topics	Contact Hours
I	Quantum Mechanics-II Operators, Hermitian Operator and its properties, quantum mechanical derivation of Heisenberg's uncertainty Principal, derivation of time –dependent Schrodinger wave equation and its Application to calculate the wave function and energy of particle moving in three dimensional box, concept of Degree of Degeneracy.	11
II	Quantum Mechanics-III (a) Application of Quantum mechanics to hydrogen like particles, Schrodinger wave equation (SWE) in terms of polar coordinates, SWE for H-like particles, separation of variables, Expression for angular spherical wave function and radial wave function, Expression for energy of H like particles.	11
III	Quantum Mechanics-III (b) Quantum numbers, calculation of quantum numbers from SWE, concept of orbitals, shapes of orbitals, calculation of energy from wave functions, energy for hydrogen molecular ion (H_2^+) and H_2 molecule. Elementary idea of variation method to obtain the correct wave function, Valence Bond Theory, Application of VBT to study of hydrogen molecule, Basics of MOT, linear combination of atomic orbitals (LCAO)- H_2^+ , Comparison of Bonding and Antibonding MO by graphical representation.	12
IV	Surface Chemistry Adsorption, types of adsorption, factors affecting adsorption, Mechanism of Adsorption, adsorption of gases by solids, adsorption isotherm, Freundlich, Langmuir and BET adsorption isotherm (including derivation). Specific surface area determination from Langmuir and BET adsorption isotherm.	11
V*	*To determine the distribution coefficient of following: I_2 between CCl_4 /Chloroform and water, Benzoic acid between benzene and water, succinic acid between benzene and water, succinic acid between ether and water. *To determine the degree of Hydrolysis and hydrolysis constant of (i) CH_3COONa and (ii) NH_4Cl . *To study the inversion of cane sugar in presence of HCl and H_2SO_4 , and hence determine the relative strength of the acids.	30
Suggested Evaluation Methods		

Internal Assesment:20+10* □ Theory ● Class Participation: 5 ● Seminar/Presentation/Assignment/Quiz/Class Test etc: 5 ● Mid Term Exam: 10 □ Practicum ● Class Participation: NA ● Seminar/Demonstration/Viva-voce/Lab records etc: 10 ● Mid-Term Exam: NA	End Term Examination: 50+20*
Part C- Learning Resources	
Recommended Books/e-resources/LMS: 1. Quantum Chemistry, I.M. Levine, Prentice Hall 2. Quantum Chemistry, R. Prasad, New age international 3. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill 4. Physical Chemistry, P.W. Atkins, Oxford university press 5. Molecular Quantum Mechanics, P.W. Atkins and R.S. Friedman, Oxford University Press	

*Applicable for courses having Practical component



DSE-3

Session 2024-25

Part A- Introduction

Subject	Chemistry		
Semester	V		
Name of Course	Elective Chemistry-IX		
Course Code	24UN-CHE-508		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE-3		
Level of Course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Enable to understand quantum mechanical operators and solve Schrodinger wave equation for particle confined in three-dimensional box. 2. To understand the basics of vibrational spectroscopy of diatomic molecules. 3. To understand the concept and utility of Nuclear Magnetic Resonance (NMR) spectroscopy 4. To understand the concept ESR and Mossbauer spectroscopy. 5*. Hand on practice in the investigations of distribution of solute in different solvents, degree of hydrolysis of organic salts.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max marks:70+30*	Time:03+03*		
Internal Assessment Marks:20+10*			
End Term Exam Marks:50+20*			

Part B- Contents of the Course

Instructions for Paper-Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.

Unit	Topics	Contact Hours
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I	Quantum Mechanics-II Operators, Hermitian Operator and its properties, quantum mechanical derivation of Heisenberg's uncertainty Principal, derivation of time –dependent Schrodinger wave equation and its application to calculate the wave function and energy of particle moving in three-dimensional box, concept of Degree of Degeneracy.	11
II	Vibrational Spectroscopy: Vibrational energy levels of simple Harmonic Oscillator, selection rules, Vibrational spectra of simple Harmonic Oscillator, Types of molecules showing vibrational spectra, Energy level of anharmonic oscillator, selection rules for the vibrational transitions in anharmonic oscillator, vibration rotational spectra of diatomic molecules. P, Q and R branches of vibration and rotational spectra, Intensities of lines in P and R branches, Results of the vibrational rotational spectrum. Elementary idea of vibrational transition of polyatomic molecules, Concept of isotopic effect by vibrational spectra.	11
III	Nuclear Magnetic Resonance (NMR) Spectroscopy: Principles of nuclear magnetic resonance, spin quantum number and angular momentum for the nucleus of (H, C, N, O and P), Concept of splitting of energy levels in a magnetic field, Concept of NMR spectra for hydrogen, NMR technique/spectrometer, Interpretation of NMR spectra (Ethyl alcohol, Ethyl acetate, Acetone, Benzaldehyde), Chemical shift, shielding and deshielding of protons, nuclear spin-spin interaction, application of NMR spectra.	12
IV	Electronic Spin Resonance Spectroscopy (ESR) Concept of ESR spectra for unpaired electron, g factor, hyperfine structure in ESR spectra, selection rules, hyperfine splitting constant, predicting lines in ESR spectra for hydrogen atom, methyl radical with energy level diagram. Difference between NMR and ESR concept. Mossbauer Spectroscopy Basic Principles of Mossbauer spectroscopy using example of iron nucleus, recoil energy, Doppler effect, Experimental arrangement of Mossbauer spectroscopy. Chemical shift.	11
V*	*To determine the distribution coefficient of following: I ₂ between CCl ₄ /Chloroform and water, Benzoic acid between benzene and water, succinic acid between benzene and water, succinic acid between ether and water. *To determine the degree of Hydrolysis and hydrolysis constant of (i) CH ₃ COONa and (ii) NH ₄ Cl. *To study the inversion of cane sugar in presence of HCl	30

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	and H ₂ SO ₄ , and hence determine the relative strength of the acids.	
Suggested Evaluation Methods		
Internal Assesment:20+10* □ Theory ● Class Participation: 5 ● Seminar/Presentation/Assignment/Quiz/Class Test etc: 5 ● Mid Term Exam: 10 □ Practicum ● Class Participation: NA ● Seminar/Demonstration/Viva-voce/Lab records etc: 10 ● Mid-Term Exam: NA		End Term Examination: 50+20*
Part C- Learning Resources		
Recommended Books/e-resources/LMS: 1. Organic Chemistry Volume III by Mukherji, Singh, Kapoor and Dass, Published by New Age International Pvt. Ltd., New Delhi. 2. Quantum Chemistry, I.M. Levine, Prentice Hall 3. Quantum Chemistry, R.K. Prasad, New age International 4. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill 5. Physical Chemistry, P.W. Atkins, Oxford university press 6. Molecular Quantum Mechanics, P.W. Atkins and R.S. Friedman, Oxford University Press 7. Kapoor, K.L. (2015), A Textbook of Physical Chemistry, McGraw Hill Education, Vol 4, 5th Edition, McGraw Hill Education. 8. Kakkar, R. (2015), Atomic & Molecular Spectroscopy, Cambridge University Press.		

*Applicable for courses having Practical component

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CC-6/ MCC-11**Session 2021-22****Part A- Introduction**

Subject	Chemistry		
Semester	VI		
Name of Course	Chemistry-VI		
Course Code	24UN-CHE-601		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC/MCC		
Level of Course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Enable to understand the chemistry of bioinorganic molecules. 2. To learn about fundamentals of photochemistry and photophysical processes. 3. To understand the concept of IR and NMR spectroscopy of organic compounds. 4. Enable to understand the synthesis and other properties of amino acids, carbohydrates and their derivatives. 5*. Hand on practice in preparation of organic/ inorganic compound, and determination of strength of various types of solutions using various instruments.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Examination Time:03+03* Hours		

Part B- Contents of the Course**Instructions for Paper-Setter****Note:** The examiner is requested to set nine questions in all, selecting two questions from each

SECTION and one question (Question No.1) based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.

Unit	Topics	Contact Hours
I	Bioinorganic chemistry Metal ions present in biological system, classification based on action (essential, non-essential, trace, toxic), Metalloporphyrins with special reference to haemoglobin and myoglobin. Biological role of Na^+ , K^+ , Ca^{+2} , Mg^{+2} , Fe^{+2} ions, Cooperativity effect, Bohr effect.	10
II	Photochemistry Interaction of radiation with matter, difference between thermal and photochemical process, Law of photochemistry: Lambert-Beer Law, Grotthuss-Draper Law, Stark Einstein Law (Law of photochemical equivalence) , calculation of integrated absorption coefficient from electronic spectra, oscillator strength, concept of singlet and triplet states, Jablonski diagram – depicting various process occurring in excited states including fluorescence , phosphorescence and non-radiative processes (internal conversion, intersystem crossing). Calculation of lifetime of excited states. Quantum Yield, Photosensitized reaction- energy transfer process (Simple example). Spectroscopy-I: Electromagnetic radiations, reasons of electromagnetic spectrum, basic features of spectroscopy, introduction to molecular spectroscopy and its difference from atomic spectroscopy, signal to noise ratio, resolving power of spectrophotometer, Born-Oppenheimer approximation, Concept of degree of freedom. Rotational Spectrum: Energy levels of rigid rotator of diatomic molecules, selection rules, spectral intensity distribution using Maxwell-Boltzmann distribution, Determination of bond length and concept of isotopic effect.	13
III	IR Spectroscopy Infrared (IR) absorption spectroscopy Molecular vibrations, Hooke's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, characteristic absorptions of various functional groups and interpretation of IR spectra of simple organic compounds. NMR Spectroscopy Principle of nuclear magnetic resonance, the PMR spectrum, number of signals, peak areas, equivalent and nonequivalent protons positions of signals and chemical shift, shielding and deshielding of protons, proton counting, splitting of signals and coupling constants, magnetic equivalence of protons. Discussion of PMR spectra of the molecules: ethyl bromide, n-propyl bromide, isopropyl bromide and 1,1-dibromoethane.	11

IV	Amino Acids, Peptides Amino acids, Peptides, and their classification. α-Amino Acids-Synthesis, ionic properties, and reactions. Zwitterions, pKa values, isoelectric point, and electrophoresis. Carbohydrates Occurrence, classification, and their biological importance. Monosaccharides: Constitution and absolute configuration of glucose	11
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	and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projection and conformational structures; Interconversion of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation.	
V*	1. To determine the strength of given acid solution (mono acid only) conductometrically. 2. To determine the solubility and solubility product of sparingly soluble salt using conductometer. 3. To determine the strength of given Mohr's salt solution using potentiometer. 4. To determine the molecular weight of organic compound by Rast method. 5. To determine the specific rotation of an optically active substance by polarimeter. 6. To prepare a sample of p-bromoaniline from p-bromoacetanilide. 7. To prepare a sample of cuprous chloride. 8. To study the photochemical reaction of benzophenone and isopropyl alcohol.	30
Suggested Evaluation Methods		
Internal Assessment: 20+10* □ Theory ● Class Participation: 5 ● Seminar/Presentation/Assignment/Quiz/Class Test etc: 5 ● Mid Term Exam: 10 □ Practicum ● Class Participation: NA ● Seminar/Demonstration/Viva-voce/Lab records etc: 10 ● Mid-Term Exam: NA		End Term Examination: 50+20*
Part C- Learning Resources		
Recommended Books/e-resources/LMS: 1. Organic Chemistry Volume II & III by Mukherji, Singh, Kapoor and Dass, Published by New Age International Pvt. Ltd., New Delhi. 2. Huheey, J.E.; Keiter, E.A., Keiter; R. L.; Medhi, O.K. (2009), Inorganic Chemistry Principles of Structure and Reactivity, Pearson Education. 3. Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A. (2010), Inorganic Chemistry, 5th Edition, W. H. Freeman and Company 4. Lee, J.D.; (2010), Concise Inorganic Chemistry, Wiley India. 5. Pavia, D. (2015), Introduction to Spectroscopy, Fifth Edition, Cengage Learning India Pvt. Learning. 6. Ahluwalia, V.K., Parashar, R.K. (2011), Organic Reaction Mechanisms, 4th Edition, Narosa Publishing House. 7. Horspool, W.M. (1976) Aspects of Organic Photochemistry, Academic Press. 8. Singh J, Awasthi S K, Singh J, Fundamentals of Organic Chemistry, Pragati Prakashan		

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9. Kapoor, K.L. (2015), A Textbook of Physical Chemistry, Vol 3, 6th edition, McGraw Hill Education.
10. Kapoor, K.L. (2015), A Textbook of Physical Chemistry, Vol 5, 6th Edition, McGraw Hill Education.
11. Kuashik, S., Singh, A. (2023), Biomolecules: From Genes to Proteins, First Edition, Berlin, Boston: De Gruyter.
12. DeMan, J.M., Finley, J.W., Hurst, W.J., Lee, C.Y. (2018), Principles of Food Chemistry, Fourth Edition, Springer

*Applicable for courses having Practical component

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MCC-12

Session: 2024-25

Part A - Introduction

Subject	Chemistry		
Semester	VI		
Name of the Course	Organic Chemistry-II		
Course Code	24UN-CHE-602		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	MCC		
Level of the course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. To understand about UV spectroscopy and analysis of UV spectra of organic compounds. 2. Get knowledge about NMR spectroscopy and to study NMR spectra of organic compounds. 3. To know about synthesis and chemical reactions of Organometallic compounds including Grignard reagents. 4. Get knowledge about synthesis and chemical reactions of heterocyclic compounds 5*. Hand on practice to synthesize various compounds and determination of their melting points.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75
Max. Marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Examination Time:03 + 03* Hours		

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.

Unit	Topics	Contact Hours
I	Ultraviolet (UV) absorption Spectroscopy Absorption laws (Beer-Lambert law), molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of	12

	conjugation. Concept of chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. UV spectra of conjugated enes and λ_{max} of simple enones, Woodward-Fieser rules, calculation of-unsaturated ketones. α , β -conjugated dienes. Application of UV in structure determination.	
II	NMR Spectroscopy Introduction to PMR. Chemical Shift and factors affecting the Chemical Shift (Hydrogen bonding, inductive effect and Anisotropic effect) Discussion of PMR spectra of the molecules: ethyl bromide, n-propyl bromide, isopropyl bromide, 1,1-dibromoethane, ethanol, acetaldehyde, ethyl acetate, toluene, benzaldehyde, acetophenone, Nitrobenzene, Aniline, Phenol, benzoic acid, p-Toluic acid. Simple problems on PMR spectroscopy for structure determination of organic compounds.	11
III	Organometallic Compounds Organomagnesium compounds: the Grignard reagents-formation, structure and chemical reactions. Organozinc compounds: formation and chemical reactions. Organolithium compounds: formation and chemical reactions.	11
IV	Heterocyclic Compounds Introduction to condensed five and six-membered heterocycles compounds. Preparation and reactions of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis. Mechanism of electrophilic substitution reactions of Indole, quinoline and isoquinoline.	11
V*	1. Preparation of 1,3,5-tribromobenzene from aniline. 2. Preparation of anthranilic acid from phthalic anhydride 3. Preparation of p-bromoaniline from acetanilide. 4. Preparation of triphenylmethyl bromide from triphenyl methane. 5. Preparation of benzoic acid from toluene/benzyl chloride. (Experiments should be carried out using minimum amount of chemicals)	30
Suggested Evaluation Methods		
Internal Assessment: 20+10* > Theory - Class Participation: 5 - Seminar/presentation/assignment/quiz/class test etc.: 5 - Mid-Term Exam: 10 > Practicum - Class Participation: NA - Seminar/Demonstration/Viva-voce/Lab records etc.: 10 - Mid-Term Exam: NA		End Term Examination: 50+20*
Part C-Learning Resources		
Recommended Books/e-resources/LMS: 1. Organic Chemistry Volume II by Mukherji, Singh, Kapoor and Dass, Published by New Age International Pvt. Ltd., New Delhi.		

2. Pavia, D. (2015), Introduction to Spectroscopy, Fifth Edition, Cengage Learning India Pvt. Learning.
3. Scheinmann, F., Introduction to spectroscopic methods for identification of organic compounds, Volume 2, Pergamon Press.
4. Huheey, J.E.; Keiter, E.A., Keiter; R. L.; Medhi, O.K. (2009), Inorganic Chemistry Principles of Structure and Reactivity, Pearson Education.
5. Lee, J.D.; (2010), Concise Inorganic Chemistry, Wiley India.
6. Finar, I.L., (2012), Organic Chemistry Volume 1, 6th Edition, Pearson Education.
7. Singh J, Awasthi S K, Singh J, Fundamentals of Organic Chemistry, Pragati Prakashan Meerut.

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DSE-4

Session 2024-25

Part A- Introduction

Subject	Chemistry		
Semester	VI		
Name of Course	Elective Chemistry-X		
Course Code	24UN-CHE-603		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE		
Level of Course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Get knowledge of theory and application of X-Ray and DLS techniques. 2. To understand the theory and application of UV, SEM & TEM techniques. Enable to understand the application of metals in bio-system. 3. Get knowledge about the quantitative analysis for unknown salts or its mixtures. 4 To learn about various separation techniques for different ions/compounds. 5*. Hand on practice in preparation and estimation of some metal complexes.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Examination Time:03+03* Hours		

Part B- Contents of the Course

Instructions for Paper-Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five

questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.

Unit	Topics	Contact Hours
I	Characterization techniques of inorganic solids-I: Theories and applications of Powder X-ray Diffraction, Brunauer–Emmett–Teller (BET) surface area analyser, Dynamic Light Scattering (DLS)	11
II	Characterization techniques of inorganic solids-II: Theories and applications of UV-visible spectroscopy, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), IR and Fourier-Transform Infrared (FTIR) spectroscopy.	11
III	Quantitative Analysis Theory of quantitative analysis. Gravimetric analysis: Preparation, structure and geometry of Ni-Dimethyl glyoxime, role of ammonia in the preparation, calculation of expected yield. Preparation, structure and geometry of Cu-isothiocyanate complex.	11
IV	Separation techniques Solvent extraction: Classification, principle and efficiency of the technique. Qualitative aspects of solvent extraction: extraction of metal ions from aqueous solution and non-aqueous media. Chromatography: Classification, principle and efficiency of the technique, ion-exchange method.	12
V*	1. Estimation of iron as Fe_2O_3 by precipitating iron as $\text{Fe}(\text{OH})_3$. 2. Preparation of potassium aluminium sulphate $\text{KAl}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$ (Potash alum), Potassium chromium sulphate $\text{KCr}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$ (Chrome alum). 3. Paper Chromatographic separation of following metal ion Ni(II) and Co(II) Fe(III) and Al(III). 4. Synthesis and purification of $[\text{Ni}(\text{diphenylamine})_4(\text{NO}_3)(\text{H}_2\text{O})](\text{NO}_3)_2$ from NiNO_3 . 5. Synthesis and purification of $[\text{Ca}(\text{EDTA})]^{2-}$ complex. 6. Synthesis and purification of $[\text{Mg}(\text{EDTA})]^{2-}$ complex.	30
Suggested Evaluation Methods		

Internal Assesment:20+10* □ Theory ● Class Participation: 5 ● Seminar/Presentation/Assignment/Quiz/Class Test etc: 5 ● Mid Term Exam: 10 □ Practicum ● Class Participation: NA ● Seminar/Demonstration/Viva-voce/Lab records etc: 10 ● Mid-Term Exam: NA	End Term Examination: 50+20*
Part C- Learning Resources	
Recommended Books/e-resources/LMS: 1. West, A. R. (2014), Solid State Chemistry and Its Application, Wiley. 2. Smart, L. E.; Moore, E. A., (2012), Solid State Chemistry: An Introduction CRC Press Taylor & Francis. 3. Rao, C. N. R.; Gopalakrishnan, J. (1997), New Direction in Solid State Chemistry, Cambridge University Press 4. Poole Jr.; Charles P.; Owens, Frank J. (2003), Introduction to Nanotechnology, John Wiley and Sons 5 Solvent Extraction: Separation of Elements with Liquid Ion Exchangers by S.M. Khopkar, 2nd Edition, New Age International. 6 Basics and Techniques of Quantitative Analysis by Anup Kumar Shrivastava, 1st Edition. 7 Characterization Methods in Inorganic Chemistry by Mark T. Weller and Nigel A. Young, Oxford	

*Applicable for courses having Practical component

DSE-4	
Session 2026-27	
Part A- Introduction	
Subject	Chemistry
Semester	VI
Name of Course	Elective Chemistry-XI
Course Code	24UN-CHE-604
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE
Level of Course (As per Annexure-I)	

Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Enable to understand the role of dioxygen carriers and also synthetic model compounds 2. To learn about basic concept of ion exchange chromatography and their utilization. 3. Get knowledge about the concept of optical rotatory dispersion and circular dichroism. 4. To understand the various basics to synthesize the inorganic solids. 5*. Hand on practice in preparation and estimation of some metal complexes.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Examination Time: 03+03* Hours		
Part B- Contents of the Course			
Instructions for Paper-Setter			
Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.			
Unit	Topics		Contact Hours
I	Bioinorganic Chemistry : Existence of Iron and its use in various bio-systems, Hemoglobin, Model compounds of dioxygen carrier, Myoglobin, cytochrome-C-oxidase ; Storage and transfer of iron,		11

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II	Ion-exchange chromatography: basic concept of ion exchange chromatography, technique, instrumentation, Column, ion-exchange chromatography. Determination of ion exchange capacity of anion / cation exchange resin (using batch procedure if use of column is not feasible).	11
III	Circular Dichroism and Optical Rotatory Dispersion Polarized light, fundamental symmetry requirements, for optical activity, interaction of polarized light with optically active matter, optical rotation, Cotton effect, configuration of Tris-chelated complexes.	11
IV	Synthesis of inorganic solids: Conventional heat and beat method, Co-precipitation method, Sol-gel method, Hydrothermal method, Chemical vapor deposition (CVD), Ion-exchange and Intercalation method.	12
V*	7. Estimation of iron as Fe_2O_3 by precipitating iron as $\text{Fe}(\text{OH})_3$. 8. Preparation of potassium aluminium sulphate $\text{KAl}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$ (Potash alum), Potassium chromium sulphate $\text{KCr}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$ (Chrome alum). 9. Paper Chromatographic separation of following metal ion $\text{Ni}(\text{II})$ and $\text{Co}(\text{II})$ $\text{Fe}(\text{III})$ and $\text{Al}(\text{III})$. 10. Synthesis and purification of $[\text{Ni}(\text{diphenylamine})_4(\text{NO}_3)(\text{H}_2\text{O})](\text{NO}_3)_2$ from NiNO_3 . 11. Synthesis and purification of $[\text{Ca}(\text{EDTA})]^{2-}$ complex. 12. Synthesis and purification of $[\text{Mg}(\text{EDTA})]^{2-}$ complex.	30
Suggested Evaluation Methods		
Internal Assesment:20+10* ☐ Theory - Class Participation: 5 - Seminar/Presentation/Assignment/Quiz/Class Test etc: 5 - Mid Term Exam: 10 ☐ Practicum - Class Participation: NA - Seminar/Demonstration/Viva-voce/Lab records etc: 10 - Mid-Term Exam: NA		End Term Examination: 50+20*
Part C- Learning Resources		



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1. Instrumental Methods of Analytical Chemistry by Willard, Merit and Dean, Settle.
2. Lippard, S.J.; Berg, J.M. (1994), Principles of Bioinorganic Chemistry, Panima Publishing Company.
3. Bioinorganic Chemistry- Inorganic Elements in the Chemistry of Life: An Introduction and Guide, 2nd Edition by Wolfgang Kaim, Brigitte Schwederski, Alex Klein.
4. Solvent Extraction: Separation of Elements with Liquid Ion Exchangers by S.M. Khopkar, 2nd Edition, New Age International.
5. Basics and Techniques of Quantitative Analysis by Anup Kumar Shrivastava, 1st Edition.
6. Rao, C. N. R.; Gopalakrishnan, J. (1997), New Direction in Solid State Chemistry, Cambridge University Press
7. 6. Poole Jr.; Charles P.; Owens, Frank J. (2003), Introduction to Nanotechnology, John Wiley and Sons

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DSE-4

Session 2021-22

Part A- Introduction

Subject	Chemistry		
Semester	VI		
Name of Course	Elective Chemistry-XII		
Course Code	24UN-CHE-605		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE		
Level of Course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Able to understand the composition of soil and their analysis 2. To know about the analysis of various food products 3. Have idea about analysis of cosmetics. 4. To know about basics of analytical chemistry. 5*. Hand on practice in preparation and estimation of some metal complexes.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Time:03+03*		

Part B- Contents of the Course

Instructions for Paper-Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.

Unit	Topics	Contact Hours
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I	Analysis of Soil: Composition of soil, concept of pH and pH measurement, complexometric titrations, chelation, chelating agents, use of indicators (only theoretical based): 1. Determination of pH of Samples. 2. Estimation of calcium and magnesium ions as calcium carbonate by complexometric titrations.	11
II	Analysis of food products: Nutritional value of foods, idea about food processing and food preservatives and adulteration.	11
III	Analysis of Cosmetics: Major and minor chemical constituents and their function, analysis of deodorants and antiperspirants, Al, Zn, Boric acid, Chlorides and sulphate base. Determination of constituents of talcum powder, coriander powder and pulses.	11
IV	Quantitative Analysis Theory of quantitative analysis. Gravimetric analysis: Preparation, structure and geometry of Ni-Dimethyl glyoxime, role of ammonia in the preparation, calculation of expected yield. Preparation, structure and geometry of Cu-isothiocyanate complex.	12
V*	*Estimation of iron as Fe_2O_3 by precipitating iron as $\text{Fe}(\text{OH})_3$. *Preparation of potassium aluminium sulphate $\text{KAl}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$ (Potash alum), Potassium chromium sulphate $\text{KCr}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$ (Chrome alum). *Paper Chromatographic separation of following metal ion Ni(II) and Co(II) Fe(III) and Al(III). *Synthesis and purification of $[\text{Ni}(\text{diphenylamine})_4(\text{NO}_3)(\text{H}_2\text{O})](\text{NO}_3)_2$ from NiNO_3 . *Synthesis and purification of $[\text{Ca}(\text{EDTA})]^{2-}$ complex. *Synthesis and purification of $[\text{Mg}(\text{EDTA})]^{2-}$ complex.	30
Suggested Evaluation Methods		

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Internal Assessment: 20+10* □ Theory ● Class Participation: 5 ● Seminar/Presentation/Assignment/Quiz/Class Test etc: 5 ● Mid Term Exam: 10 □ Practicum ● Class Participation: NA ● Seminar/Demonstration/Viva-voce/Lab records etc: 10 ● Mid-Term Exam: NA	End Term Examination: 50+20*
Part C- Learning Resources	
Recommended Books/e-resources/LMS: 1. Basics and Techniques of Quantitative Analysis by Anup Kumar Shrivastava, 1st Edition. 2. Willard, H.L. Merritt, L.L., Dean, J. & Settle, F.A. Instrumental methods of analysis, 7th Ed. Wadsworth publishing Co. Ltd., Belmont, California, USA, 1988. 3. Chemistry 6th ed., Saunders College Publishing, fort Worth (1992). 4. Harris, D.C. quantitative Chemical Analysis, W. H. Freeman. 5. Dean, J.A. Analytical Chemical Notebook, McGraw Hill.	

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DSE-5**Session 2024-25****Part A- Introduction**

Subject	Chemistry		
Semester	VI		
Name of Course	Elective Chemistry-XIII		
Course Code	24UN-CHE-606		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE		
Level of Course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. To know the basic concepts of nuclear chemistry and various processes occurs during the nuclear reactions. 2. Have knowledge about basic of catalysis and their relative aspects. 3. To get information about colloidal state. 4. To learn about macromolecules and obtain basic knowledge of liquid crystals. 5*. Hand on practice in study of optical properties and various kinetic parameters.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Examination Time: 03+03* Hours		

Part B- Contents of the Course**Instructions for Paper-Setter**

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-

programmable calculator is allowed.

Unit	Topics	Contact Hours
I	Nuclear Chemistry Radioactivity, rays from radioactive materials, Radioactive disintegration, Half-life period, Radioactive equilibrium. Steady State, Theory of Radioactivity, carbon dating, radioactive isotopes, radiochemical principle in the use of tracers, application of tracers in chemical investigation, physicochemical methods, age determination and agricultural applications.	11
II	Catalysis General characteristics of catalytic reactions, acid-base catalysis, enzyme catalysis, Michaelis-Menten equation, Effect of temperature on enzyme catalysis, heterogeneous catalysis, surface reactions, Kinetics of unimolecular surface reaction, pH-dependence of rate constants of catalyzed reactions. Autocatalysis.	11
III	Colloidal State: Colloids – Lyophilic and Lyophobic, properties of colloidal systems, Surfactants and its types, micelle formation, critical micelle concentration (CMC), factor affecting CMC, methods to determine CMC (electrical conductivity and surface tension), solubilization, emulsification - Emulsions, emulsifiers, factors determining stability of emulsions. Gels - Elastic and Non-elastic gels. Importance and applications of colloids.	11
IV	Macromolecules Polymers, Classification of polymers and examples, degree of polymerization, types of polymerization reactions with examples only, Molar mass of polymers: Number average method and weight average method and related numericals. Determination of molar mass of macromolecules by viscometry. Liquid Crystals Mesomorphic state, classification of liquid crystals and molecular arrangements in various states, applications of liquid crystals.	12
V*	1. Investigate the autocatalytic reaction between potassium permanganate and oxalic acid. 2. Study the kinetics of saponification of ethyl acetate by sodium hydroxide at two temperatures by conductance measurements, and hence determine the energy of activation of the reaction. 3. Determine the order of hydrolysis of ethyl acetate by sodium hydroxide. 4. Determine the velocity constant of hydrolysis of ethyl acetate by sodium hydroxide. 5. Determine the molar refractivity of ethyl acetate and benzene by Abbe's refractometer.	30

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	6. Determine the electron polarization and electron Polarizability of a liquid using Abbe's refractometer. 7. Determine the composition of an unknown mixture of two given liquids by refractive index measurements.	
Suggested Evaluation Methods		
Internal Assesment:20+10* ☐ Theory ● Class Participation: 5 ● Seminar/Presentation/Assignment/Quiz/Class Test etc: 5 ● Mid Term Exam: 10 ☐ Practicum ● Class Participation: NA ● Seminar/Demonstration/Viva-voce/Lab records etc: 10 ● Mid-Term Exam: NA		End Term Examination: 50+20*
Part C- Learning Resources		
Recommended Books/e-resources/LMS: 1. Arnikar, H.J., (1987), Second Edition, Essentials of Nuclear Chemistry, Wiley Blackwell Publishers. 2. Arnikar, H.J.; Rajurkar, N. S.,(2016) Nuclear Chemistry through Problems, New Age International Pvt. Ltd. 3. Kapoor, K.L. (2015), A Textbook of Physical Chemistry, Vol 3, 6th Edition, McGraw Hill Education. 4. Kapoor, K.L. (2015), A Textbook of Physical Chemistry, Vol 5, 3rd Edition, McGraw Hill Education. 5. Laidler K.J. (2003), Chemical Kinetics, 3rd Edition, Pearson Education India 6. Campbell, Ian M., (2000), Introduction to Synthetic Polymers, Second Edition, Oxford University Press, USA. 4. Bahadur, P. and Sastry, N.V. (2002) Principles of Polymer Science Narosa, New Delhi. 7. Khopkar, S.M. (2008), Basic Concepts of Analytical Chemistry, New Age International Publisher.		

*Applicable for courses having Practical component

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Session 2024-25			
Part A- Introduction			
Subject	Chemistry		
Semester	VI		
Name of Course	Elective Chemistry-XIV		
Course Code	24UN-CHE-607		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE		
Level of Course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. To know the basic concepts of classical and quantum statistics. 2. Students may enable to understand the calculation of thermodynamic properties from statistics. 3. To get information of partition function and leads to get physical properties of systems. 4. To learn about the concept and qualitative treatment of simple harmonic oscillator and Rigid rotator. 5* Hand on practice in study of Adsorption phenomenon and various kinetic parameters.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Examination Time:03+03* Hours		
Part B- Contents of the Course			

Instructions for Paper-Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.

Unit	Topics	Contact Hours
I	Statistical Mechanics: Concept of Classical statistics, Classical Statistical mechanics: Postulates, microcanonical, canonical, grand canonical ensembles; non-interacting examples. Statistical analysis of Maxwell-Boltzmann's distribution law. Quantum Statistical Mechanics: Concept of quantum statistics for distinguishable and in distinguishable molecules. Quantization effect in molecular gases, phonons, photons, degenerate quantum gases; Concept and statistical distribution of Fermions and Bosons.	11
II	Statistical Thermodynamics-I: Need for Statistical Thermodynamics, Significance of Boltzmann constant, thermodynamic probability, relationship between entropy and probability, partition function, expression for thermodynamic functions in terms of partition function, heat content, heat capacity at constant volume/constant pressure, entropy, Gibbs free energy and Helmholtz free energy, separation of partition function into translational, rotational, vibrational and electronic partition function.	11
III	Statistical Thermodynamics- II: Expression for translational, rotational and vibrational partition functions, Thermal de Broglie wavelength, characteristics rotational temperature, Relationship between internal energy and partition function, Thermodynamic functions, contribution of translational partition function to express translational energy; Sackur Tetrode equation, Contribution of rotational and vibrational partition function to express rotational/vibrational energy, heat content, heat capacity at constant volume/constant pressure, entropy, Helmholtz free energy and Gibbs free energy.	11
IV	Rigid rotator: Rigid rotator model for rotation of diatomic molecules, expression for energy levels, degree of degeneracy. Harmonic oscillator: Concept and qualitative treatment of simple harmonic oscillator model of vibrational motion, classical and quantum mechanical treatment for harmonic oscillation, results of harmonic oscillator. Expression for wave functions of harmonic oscillator (derivation included)	12

V*	8. Investigate the adsorption of oxalic acid from aqueous solutions by activated charcoal, and examine the validity of classical and Langmuir's adsorption isotherm. 9. Determine the adsorption isotherm of acetic acid from aqueous solution by charcoal. 10. Investigate the autocatalytic reaction between potassium permanganate and oxalic acid. 11. Study the kinetics of saponification of ethyl acetate by sodium hydroxide at two temperatures by conductance measurements, and hence determine the energy of activation of the reaction. 12. Determine the order of hydrolysis of ethyl acetate by sodium hydroxide. 13. Determine the velocity constant of hydrolysis of ethyl acetate by sodium hydroxide. 14. Study the inversion of cane sugar in presence of HCl and H ₂ SO ₄ acids, and hence determine the relative strength of the acids.	30
Suggested Evaluation Methods		
Internal Assessment:20+10* ☐ Theory • Class Participation: 5 • Seminar/Presentation/Assignment/Quiz/Class Test etc: 5 • Mid Term Exam: 10 ☐ Practicum • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc: 10 • Mid-Term Exam: NA		End Term Examination: 50+20*
Part C- Learning Resources		
Recommended Books/e-resources/LMS: 1. Kapoor, K.L. (2015), A Textbook of Physical Chemistry, McGraw Hill Education, Vol 4, 5th Edition, McGraw Hill Education. 2. House, J.E. (2004), Fundamentals of Quantum Chemistry, 2nd Edition, Elsevier. 3. McQuarrie, D.A. (2016), Quantum Chemistry, Viva Books. 4. Chandra, A. K. (2001), Introductory Quantum Chemistry, Tata McGraw-Hill. 5. House, J.E. (2004), Fundamentals of Quantum Chemistry, 2nd Edition, Elsevier. 6. Statistical Thermodynamics 2nd Edition M.C.Gupta.		

*Applicable for courses having Practical component

The block contains several handwritten signatures and initials in blue ink. On the left, there is a large, stylized signature. In the center, there is a signature that appears to read 'Ravi Kant'. To the right, there are two more signatures, one of which is more legible and appears to read 'Sanku'. There are also some smaller, less distinct initials scattered around.

DSE-5

Session 2024-25			
Part A- Introduction			
Subject	Chemistry		
Semester	VI		
Name of Course	Elective Chemistry-XV		
Course Code	24UN-CHE-608		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE		
Level of Course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. To know the basic concepts of nuclear chemistry and various processes occurs during the nuclear reactions. 2. Have knowledge about basic of catalysis and their relative aspects. 3. To get information of partition function and leads to get physical properties of systems. 4. To learn about the concept and qualitative treatment of simple harmonic oscillator and Rigid rotator. 5* Hand on practice in study of Adsorption phenomenon and various kinetic parameters.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Time: 03+03*		
Part B- Contents of the Course			

Instructions for Paper-Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.

Unit	Topics	Contact Hours
I	Nuclear Chemistry: Radioactivity, rays from radioactive materials, Radioactive disintegration, Half-life period, Radioactive equilibrium. Steady State, Theory of Radioactivity, carbon dating, radioactive isotopes, radiochemical principle in the use of tracers, application of tracers in chemical investigation, physicochemical methods, age determination and agricultural applications.	11
II	Catalysis General characteristics of catalytic reactions, acid-base catalysis, enzyme catalysis, Michaelis-Menten equation, Effect of temperature on enzyme catalysis, heterogeneous catalysis, surface reactions, Kinetics of unimolecular surface reaction, pH-dependence of rate constants of catalyzed reactions. Autocatalysis.	11
III	Statistical Thermodynamics-I: Need for Statistical Thermodynamics, thermodynamic probability, relationship between entropy and probability, partition function, expression for thermodynamic functions in terms of partition function, heat content, heat capacity at constant volume and at constant pressure, entropy, Helmholtz free energy and Gibbs free energy, separation of partition function into translational, rotational, vibrational and electronic partition function. Expression for translational, rotational and vibrational partition functions.	11
IV	Rigid rotator: Rigid rotator model for rotation of diatomic molecules, expression for energy levels, degree of degeneracy. Harmonic oscillator: Concept and qualitative treatment of simple harmonic oscillator model of vibrational motion, classical and quantum mechanical treatment for harmonic oscillation, results of harmonic oscillator. Expression for wave functions of harmonic oscillator (derivation included)	12
V*	*Investigate the adsorption of oxalic acid from aqueous solutions by activated charcoal, and examine the validity of classical and Langmuir's adsorption isotherm. *Determine the adsorption isotherm of acetic acid from	30

	aqueous solution by charcoal. *Investigate the autocatalytic reaction between potassium permanganate and oxalic acid. *Study the kinetics of saponification of ethyl acetate by sodium hydroxide at two temperatures by conductance measurements, and hence determine the energy of activation of the reaction. *Determine the order of hydrolysis of ethyl acetate by sodium hydroxide. *Determine the velocity constant of hydrolysis of ethyl acetate by sodium hydroxide. *Study the inversion of cane sugar in presence of HCl and H₂SO₄ acids, and hence determine the relative strength of the acids.	
Suggested Evaluation Methods		
Internal Assesment:20+10* □ Theory ● Class Participation: 5 ● Seminar/Presentation/Assignment/Quiz/Class Test etc: 5 ● Mid Term Exam: 10 □ Practicum ● Class Participation: NA ● Seminar/Demonstration/Viva-voce/Lab records etc: 10 ● Mid-Term Exam: NA		End Term Examination: 50+20*
Part C- Learning Resources		
Recommended Books/e-resources/LMS: 1. Kapoor, K.L. (2015), A Textbook of Physical Chemistry, McGraw Hill Education, Vol 4, 5th Edition, McGraw Hill Education. 2. House, J.E. (2004), Fundamentals of Quantum Chemistry, 2nd Edition, Elsevier. 3. McQuarrie, D.A. (2016), Quantum Chemistry, Viva Books. 4. Chandra, A. K. (2001), Introductory Quantum Chemistry, Tata McGraw-Hill. 5. House, J.E. (2004), Fundamentals of Quantum Chemistry, 2nd Edition, Elsevier 6. Statistical thermodynamics 2 nd Edition M.C.GUPTA 7. Arnika, H.J.; Rajurkar, N. S.,(2016) Nuclear Chemistry through Problems, New Age International Pvt. Ltd. 8. Kapoor, K.L. (2015), A Textbook of Physical Chemistry, Vol 3, 6th Edition, McGraw Hill Education.		

*Applicable for courses having Practical componen

Session: 2024-25

Part A – Introduction

Subject	Chemistry		
Semester	III		
Name of the Course	Food Adulteration Testing		
Course Code	22UN-CHE-SEC601		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	SEC		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1 Know about common food adulterants 2 Learn methods of detection of adulterants in food 3 Get aware about laws related with adulteration 4 Understand the role of several agencies. _____ 5*. Practically detect adulteration in foods.		
Credits	Theory	Practical	Total
	2	1	3
Contact Hours	30	30	60
Max. Marks: 50+25* Internal Assessment Marks: 15+5* End Term Exam Marks: 35+20*		Time: Theory: 3 Hours Practicum: 3 Hours	

Part B- Contents of the Course**Instructions for Paper- Setter**

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on

entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory.

Unit	Topics	Contact Hours
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I	Common Foods and Adulteration Common Foods subjected to Adulteration - Adulteration Definition – Types; Poisonous substances, Foreign matter, Cheap substitutes, Spoiled parts. Adulteration through Food Additives – Intentional and incidental. General Impact on Human Health.	8 Hrs
II	Adulteration of Common Foods and Methods of Detection Means of Adulteration, Methods of Detection Adulterants in the following Foods; Milk, Oil, Grain, Sugar, Spices, Processed food, Fruits and vegetables. Additives and Sweetening agents (at least three methods of detection for each food item).	8 Hrs
III	Present Laws and Procedures on Adulteration Highlights of Food Safety and Standards Act 2006 (FSSA) –Food Safety and Standards Authority of India–Rules and Procedures of Local Authorities.	7 Hrs
IV	Role of voluntary agencies such as, Agmark, I.S.I. Quality control laboratories of companies, Private testing laboratories, Quality control laboratories of consumer co-operatives. Consumer education, Consumer's problems rights and responsibilities, COPRA 2019 - Offenses and Penalties – Procedures to Complain – Compensation to Victims.	7 Hrs
V*	1. Determination of urea & starch in milk. 2. Determination of starch in Khoa products. 3. Determination of Margarine in Ghee. 4. Determination of Metanil yellow colour in Jaggery. 5. Determination of colored saw dust in turmeric powder.	30 Hrs

Suggested Evaluation Methods
Short Answer and MCQ Type QUESTIONS

Internal Assessment: 15

➤ **Theory**

- Class Participation: 04
- Seminar/presentation/assignment/quiz/class test etc.: 04
- Mid-Term Exam: 07

➤ **Practicum: 05**

- Class Participation: 02
- Seminar/Demonstration/Viva-voce/Lab records etc.: 03
- Mid-Term Exam: NIL

End Term

Examination:
35+20*

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- ✓ Bright Siaw Afriyie, Introduction to Computer fundamentals.
- ✓ First course in Food Analysis – A.Y. Sathe, New Age International(P)Ltd.,1999
- ✓ Food Safety, case studies – Ramesh. V. Bhat, NIN, 1992
- ✓ https://old.fssai.gov.in/Portals/0/Pdf/Draft_Manuals/Beverages_and_confectionary.pdf
- ✓ <https://cbseportal.com/project/Download-CBSE-XII-Chemistry-Project-Food-Adulteration#gsc.tab=0>
- ✓ <https://www.fssai.gov.in/>
- ✓ <https://indianlegalsolution.com/laws-on-food-adulteration/>
- ✓ <https://fssai.gov.in/dart/>
- ✓ <https://byjus.com/biology/food-adulteration/>
- ✓ Wikipedia
- ✓ Vikaspedia

*Applicable for courses having practical component.

Session: 2024-25			
Part A – Introduction			
Subject	Chemistry		
Semester	VI		
Name of the Course	Green laboratory Techniues		
Course Code	24UN-CHE-VOC-3		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	VOC		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. learn about green chemistry; 2. describe, how injudicious use of chemicals can have an adverse/potentially damaging effect on humans and the environment. 3. propose ideas for innovative approaches to energy challenges. 4. convert biomass into valuable chemicals through green technologies. 5*. Hands on training towards green chemistry		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75
Max. Marks: 70 + 30* Internal Assessment Marks: 20 + 10* End Term Exam Marks: 50 + 20*		Time: Theory: Three Hours Practicum: Three Hours	
Part B- Contents of the Course			
<u>Instructions for Paper- Setter</u> Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory.			
Unit	Topics		Contact Hours

I	Scheme for the traditional as well as green method for the synthesis of ibuprofen. Compare the amount and hazards of waste generated in both Green Methods in Chemistry. Preparation of propene by two methods can be studied (I) Hoffman elimination (II) Dehydration of propanol	11 Hrs
II	Prevention/ minimization of hazardous/ toxic products reducing toxicity. Risk = (function) hazards exposure: (a) Nitration of salicylic acid using green method $\text{Ca}(\text{NO}_3)_2$ (b) Preparation of dibenzalacetone by cross aldol condensation reaction using base catalysed green method (c) Acetylation of primary aromatic amine using the green method. Use of Green solvents and comparison of greenness of solvents: (a) Introduction to water as a solvent for chemical reactions. preparation of Manganese (III) acetylacetonate using green method (b) Advantages and application of solventless processes in organic reactions. (c) Benzil- Benzilic acid rearrangement in solid State under solvent-free Condition.	12 Hrs
III	Energy requirements for reactions – alternative sources of energy: use of microwaves and photochemical energy. (a) Photoreduction of benzophenone to benzopinacol in the presence of sunlight. (b) Microwave assisted ammonium formate-mediated Knoevenagel reaction: p-anisaldehyde, ethyl cyanoacetate, ammonium formate.	11 Hrs
IV	Importance of using catalytic reagents in preference to stoichiometric reagents; catalysis and green chemistry, comparison of heterogeneous and homogeneous catalysis, biocatalysis, asymmetric catalysis and photocatalysis. (a) Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide (b) Rearrangement of diazoamino benzene to p-aminoazo benzene using K10 montmorillonite clay	11 Hrs
V*	1. Dehydration of propanol 2. Nitration of salicylic acid using calcium nitrate 3. Photoreduction of benzophenone to benzopinacol in the	30 Hrs
	presence of sunlight 4. Microwave assisted solvent free synthesis of aspirin 5. Synthesis of vitamin D3 using photochemical energy	

Suggested Evaluation Methods
Short Answer and MCQ Type QUESTIONS

Internal Assessment: 20+10*=30

➤ **Theory: 20**

- Class Participation: 05
- Seminar/presentation/assignment/quiz/class test etc.: 05
- Mid-Term Exam: 10

➤ **Practicum: 10**

- Class Participation: 05
- Seminar/Demonstration/Viva-voce/Lab records etc.: 05
- Mid-Term Exam: N. A.

End Term

Examination: 70
(50+20*)

Part C-Learning Resources

Recommended Books/e-resources/LMS:

Theory:

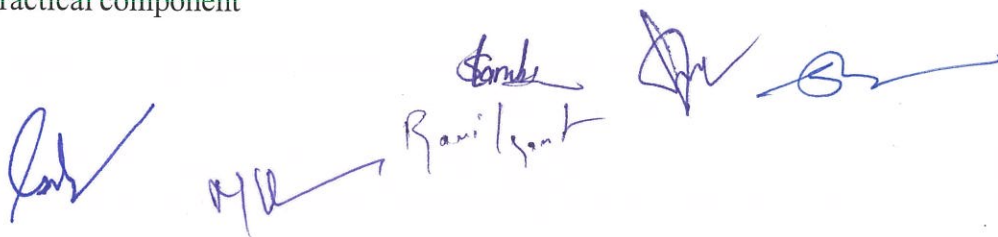
- ✓ Anastas, P.T., Warner, J.C. (2014), Green Chemistry, Theory and Practice, Oxford University Press.
- ✓ Lancaster, M. (2016), Green Chemistry: An Introductory Text, 3rd Ed., RSC Publishing.
- ✓ Cann, M.C., Connely, M. E. (2000), Real-World cases in Green Chemistry, American Chemical Society, Washington.
- ✓ Matlack, A.S. (2010), Introduction to Green Chemistry, 2nd Ed., CRC Press.
- ✓ Alhuwalia, V.K.; Kidwai, M.R. (2012), New Trends in Green chemistry, Kluwer Academic Publishers, Springer.
- ✓ Sidhwani, I.T; Sharma, R.K. (2020), An Introductory Text on Green Chemistry, Wiley India Pvt Ltd.
- ✓ Etzkorn, F. A . (2019), Green Chemistry: Principles and Case Studies, Royal Society of Chemistry.

Practicals:

- ✓ Kirchoff, M., Ryan, M.A. (2002), Greener approaches to undergraduate chemistry experiment, American Chemical Society, Washington DC.
- ✓ Sharma, R.K., Sidhwani, I.T., Chaudhari, M.K. (2013), Green Chemistry Experiments: A monograph, I.K. International Publishing House Pvt Ltd. New Delhi.
- ✓ Pavia, D.L., Lamponam, G.H., Kriz, G.S.W. (2006), Introduction to organic Laboratory Technique- A Microscale approach, 4th Edition, Brooks-Cole Laboratory Series for Organic chemistry.
- ✓ Sidhwani, I.T. ; Saini, G.; Chowdhury, S. Wealth from Waste: A green method to produce biodiesel from waste cooking oil and generation of useful products from waste further generated. University of Delhi, Journal of Undergraduate Research and Innovation, Volume 1, Issue 1, February 2015, ISSN: 2395-2334.

Sharma, R. K., Gulati, S., Mehta, S. (2012), Preparation of Gold Nanoparticles Using Tea: A Green Chemistry Experiment, Journal of Chemical Education, 89 (10), 1316-1318

*Applicable for courses having practical component

The block contains several handwritten signatures and initials in blue ink. From left to right, there is a signature that appears to be 'Saini', followed by the initials 'M/K', then a signature that looks like 'Ravi Kant', and finally two more signatures on the right side of the page.

